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THE "SOCIETY OF PUBLIC ANALYSTS."

A MONTHLY JOURNAL FOR THE INFORMATION OF THOSE INTERESTED
IN THE PURITY OF FOOD AND DRUGS, AND IN GENERAL
ANALYTICAL AND MICROSCOPICAL RESEARCH

EDITED BY

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THE ANALYST.

JANUARY, 1883.

TO OUR READERS.

With this number we commence our eighth volume; or, including the volume previously published, of "Proceedings of the Society of Public Analysts" (which was subsequenty incorporated with The Analyst), our ninth volume.

We issue with it the index for the past year, which, we think, will show that, as regards quantity and quality of matter, we have at any rate kept up to the mark.

For the last two years we have published monthly a series of Analyses of the Public Water Supplies of the principal towns of Great Britain and Ireland. These analyses have been made at considerable cost, both of time and money, by over fifty analysts at the request of the Society, and without any payment from the Water Companies or Corporations who have supplied the water, but simply for the purpose of disseminating a knowledge not only as to the characteristics of the supplies themselves, but also as to the monthly variations which might take place in them; they have, in fact, been purely independent analyses.

We have printed in all nearly 1,000 analyses, which have been made upon an uniform system, and reported in such a way as to be directly comparable one with another, thus constituting the largest series of uniform analyses of water supplies which have ever been published by any private body of analysts.

Most of the gentlemen who have acted with us in this matter have now, however, come to the conclusion that we need not any longer incur the cost of such a monthly systematic publication, and with this we quite agree. The object of the Society was to draw public attention to the character of the water used for drinking purposes in different parts of the Kingdom, and to give facilities which were not then available for judging of the relative qualities. This intention, we think, has been most amply fulfilled.

We purpose, when we have made the necessary arrangements, to publish, at intervals, a series of complete mineral analyses of the leading supplies, elaborating the analyses in such a way as to show (according to a scheme which we hope to detail shortly in this journal) such full particulars of the mineral constituents of each water as will enable a fair judgment to be formed as to the influence, if any, which these constituents exercise upon the death-rate of the towns. This point has frequently been raised, but the data upon which any conclusion as regards the influence of the water supply could be founded have not hitherto been forthcoming.

In addition to this, we hope, with the assistance of the analysts who have hitherto worked with us, and perhaps some others, to publish occasionally a series of analyses of public supplies, which, although not sufficient to show the monthly variations and their character, may be enough to show that the general standard of purity is or is not kept up.

As Editors we must tender to the Analysts who have gratuitously assisted in the work, the thanks, not only of ourselves, but of the Society by whose request the analyses have been made, for the labour they have undertaken in connection with those analyses, which labour has been rendered all the more heavy by the fact that, from the necessity of monthly publication, it has had to be done regularly, and doubtless in many cases at considerable inconvenience.

As regards other matter, we hope, during the coming year to do even more than maintain the position which The Analyst has already attained, and to do all we can to introduce any new features which may be of interest to our readers.

The following is the list of Analysts to whom the water reports are to be credited—

M. A. Adams.
A. H. Allen.
A. Angell.
L. Archbutt.
A. Ashby.
J. Baynes.
J. Carter-Bell.
J. W. Biggart.
C. M. Blades.
T. P. Blunt.
A. Wynter-Blyth.
C. A. Cameron.
H. F. Cheshire.
T. A. Collinge.
W. G. Crook.
A. Dupre.
B. Dyer.
W. L. Emmerson.
C. Estcourt.
T. Fairley.
J. W. Gatehouse.
R. H. Harland
S. Harvey.
O. Hehner.
C. Heisch.
A. Hill.
A. Bostock Hill
G. Jarmain.
W. Johnstone.
E. W. T. Jones.
J. Falconer King.
A. Kitchin.
J. West-Knights.
H. Leffman.
W. Morgan.
J. Muter.
J. Napier.
R. Oxland.
J. Pattinson.
F. B. Perkins.
W. E. Porter.
F. M. Rimmington.
J. Shea.
A. Smetham.
A. P. Smith.
W. F. K. Stock.
F. W. Stoddart.
H. Swete.
W. Sykes.
W. Thomson.
W. H. Watson.
G. W. Wigner.
H. J. Yeld.

SOCIETY OF PUBLIC ANALYSTS.

A General Meeting of this Society was held at Burlington House, Piccadilly, on 13th December.

In the absence of the President, the chair was taken by Mr. Wynter Blyth.

The Minutes of the previous Meeting were read and confirmed.

Mr. Adams and Mr. Dyer were appointed Auditors to examine the Accounts for the current year.

Mr. Dyer and Mr. Hehner were appointed Scrutineers to examine the voting papers, and reported that the following gentlemen had been duly elected.—

As Members: E. J. Day, M.R.C S., &c., Public Analyst, Dorchester; G. T. Stephens, B Sc., Analytical Chemist, Hereford; C. R. Fletcher, State Assayer, Boston, Mass.

As Associates: C. Brisley, Assistant to Dr. Bernays; F. W. Simpson, Assistant Analyst to Midland Railway Company.

Mr. A. P. Stokes, Public Analyst for Paddington and Bethnal Green, was proposed for election as a member.

The following papers were read and discussed:—

"Some Analyses of Asphalte Paving," by C. T. Kingzett.

"Examination of Beers obtained from Beersellers and Brewers," by J. Carter Bell

"On the Work of the Paris Municipal Laboratory," by W. Douglas Hogg.*

"On Decomposed Milk," by F. P. Perkins.

The Annual Meeting of the Society will be held at Burlington House, on Wednesday, 17th January, and the Annual Dinner will afterwards be held. Particulars will be sent to members as usual.

A POINT CONCERNING MILK CONTROL.

By Dr. P. Vieth, F.C.S.

Read before the Society of Public Analysts on 15th November, 1882.

In the early part of this year I made an investigation with the view to ascertain whether there is in the milk delivery churns a rise of cream to a considerable extent during the time in which the milk is delivered to the customers. I selected for my experiment a round which goes rather far, to Chiswick, had the milk in the churn thoroughly mixed, and a sample drawn from the tap of the churn just before the man left the yard of the Aylesbury Dairy Company's premises, St. Petersburgh Place, Bayswater, at one o'clock. One of the company's inspectors had orders to take two more samples about at the beginning and towards the end of the delivery. These samples were taken at 2.45 and 5.20 in the afternoon. The three samples were analysed, with the following result :—

---

* We are compelled to hold over these papers until our next number.—Ed. *Analyst.*

	Spec. grav.	Tot. solids.	Fat.	Sol. n. fat.
1. Sample taken before milk was sent out	1·0335	13·05°/o	3·30°/o	9·75°/o
2. " " on the round at 2.45 o'clock......	1·0335	13·13 "	3·40 "	9 73 "
3. " " " " " 5·20 "	1·0330	13·24 "	3·50 "	9·74 "

These figures prove that there had not been any considerable alteration in the milk, and this result quite agrees with those I find every day with the regular samples taken by our inspectors from the men when working their rounds.

It is only a very short time ago since I met with a milk which behaved very differently. There is a sample taken from each round before it leaves the yard. On the 28th of October one of these samples showed the unusually high specific gravity of 1·0345. The sample was analysed, as was likewise a sample of the milk brought back from the round. The results were as follows :—

	Spec. grav.	Tot. solids.	Fat.	Sol. h. fat.
1. Sample taken before sent out	1·0345	12·18°/o	2·60°/o	9 58°/o
2. " " as returned	1·0335	13 32 "	3·70 "	9·62 "

The day after the next, October 30th, a sample of milk from the same farmer was taken immediately after the milk had arrived in the dairy, and had been thoroughly mixed; that took place at 12 o'clock. The milk was then turned over from the railway churn into the delivery churn, and a second sample drawn from the tap of the latter, before it went out, at one o'clock. A third sample was taken of the milk returned at five o'clock.

The results of analysing these three samples were as follows :—

	Spec. grav.	Tot. solids.	Fat.	Sol. n. fat.
1. Sample taken at 12 o'clock..................	1·0330	13·86°/o	4·20°/o	9·66°/o
2. " " " 1 "	1·0345	12·70 "	3·00 "	9·70 "
3. " " " 5 "	1·0330	13·66 "	4·10 "	9·56 "

On the 31st of October a sample was again taken of the milk, when delivered into the dairy, and properly mixed. One hour later two other samples were taken, one from the top and one from the bottom of the churn—the latter drawn from the tap. The composition of these three samples is given in the following figures :—

	Spec. grav.	Tot. solids.	Fat.	Sol. n. fat.
1. Sample taken at 12 o'clock	1·0330	13·36°/o	3·90°/o	9·46°/o
2. " " " 1 " from the top	1·0245	20·96 "	11·50 "	9·46 "
3. " " " " " " " bottom	1·0340	12·40 "	2·90 "	9·50 "

Finally, on the 1st of November, I had samples taken as follows :—The first sample at one o'clock, before the milk left the yard, three samples on the round, at two, three, and four o'clock, and a fifth sample of the milk returned at five o'clock. The analytical examination of these five samples gave the following results :—

	Spec. grav.	Tot. solids.	Fat.	Sol. n. fat.
1. Sample taken at 1 o'clock	1·0325	13·30°/o	3·90°/o	9·40°/
2. " " " 2 "	1·0345	12·04 "	2·50 "	9·54 "
3. " " " 3 "	1·0350	11·86 "	2·30 "	9·56 ,
4. " " " 4 "	1·0305	15·80 "	6·40 "	9·4 "
5. " " " 5 "	1·0290	16·32 "	6·90 "	9·42

From this day the milk concerned was not sent out any more. The milk referred to was brought to London by rail from a distance of about seventy-two miles. It had always a quite normal appearance and reaction. Set aside in a cremometer, an extensive and distinct layer of cream is thrown up in the short time of half an hour. On microscopical examination, the fat globules were found to be of larger size than usual.

I think it rather an uncommon occurrence that milk throws up the cream so quickly, as shown in the preceding case; but as such cases may happen, it will be good to keep this point in mind when judging milk samples taken in the street.

SOME ANALYSES OF ASPHALTE PAVINGS.

By C. T. Kingzett, F.I.C., F.C.S.

Read before the Society of Public Analysts on December 13th, 1882.

Some time ago, in the course of professional practice, I had occasion to analyse certain specimens of asphaltic pavements, and, as at that time I failed to find any similar analyses recorded, I think the following particulars will prove of some service to other members of the profession.

Methylated alcohol and pure ethylic alcohol do not serve for the purpose of extracting the bituminous constituents of asphalte paving, and methylated ether and benzene only serve as partial or imperfect solvents. Mineral naphtha serves well, but turpentine answers better. In my analyses, Russian turpentine was employed.

The method of analysis was as follows:—Each sample was air-dried, extracted with successive amounts of Russian turpentine; the extracts distilled or evaporated to free the bituminous constituents from the solvent, and the said constituents, dried at 100°C. and weighed. The insoluble portion was washed with ether, dried, and treated first in the cold and then warmed with dilute hydrochloric acid and the acid solution examined quantitatively for calcium and magnesium, by precipitating the calcium as oxalate and weighing the reduced lime, and precipitating the magnesium as ammonia phosphate, and weighing as pyrophosphate; the portion insoluble in hydrochloric acid, being washed, dried, ignited and weighed, is expressed in the several analyses as grit.

In order to work according to some acceptable standard, and for other reasons which I need not give here, I obtained specimens of Limmer rock asphalte, the mastic as prepared therefrom at the quarries and the paving as made and laid down in this country.

The analyses made by me showed that these substances were composed as follows:—

	(1)	(2)	(3)
	Rock	Mastic	Paving
Bitumen	13 05	17 20	20 72
Carbonate of Calcium ($CaCO_3$)	84 45	78 24	63·29
Grit	1 77	4 55	15·50
Undetermined matter	·73	01	·49
	100·00	100 00	100·00

In passing, I may mention that the mastic is made from the rock by melting it down with a certain proportion of natural bitumen, and that after the arrival of the mastic in this country it is re-melted with a further quantity of bitumen, the requisite amount of grit being then added. The bituminous material used by the Limmer Company is, I am informed, Trinidad pitch melted with schist or shale oil.

My investigation included a specimen of another mastic and a number of pieces of pavement, and the following analysis will serve to indicate in what respects they differed from the products I have already referred to—

(4)

SAMPLE OF MASTIC.

Bitumen	22·46
$CaCO_3$	70·91
Grit (Silica, &c.)	6·39
$MgCO_3$ and Undetermined	·24
	100·00

Paving understood to be made from the Mastic last described—

(5)

Bitumen	17·95
$CaCO_3$	65·52
$MgCO_3$	9·53
Grit	6·74
Undetermined	·26
	100·00

Other samples of Paving.

	(6) FOOTPATH SAMPLE.	(7) CROSSING SAMPLE.	AVERAGE.
Bitumen	15·82	18·58	17·20
$CaCO_3$	78·22	75·34	76·78
Grit	4·86	6·17	5·51
Undetermined	1·10	—	·55
	100·00	100·09	100·04

Samples of a further and distinct paving—

	(8)	(9)	
Bitumen	19·46	18·22	
$CaCO_3$	57·84	58·95	
$MgCO_3$	1·86	2·17	
Grit	20·84	21·01	
Undetermined			
	100·00	100·35	100·00

In making the remarks which follow, it will be understood that they are intended to be general ones, and that I leave entirely out of consideration the particular issues that were immediately before me at the time the analyses were made.

I was not required to make any special investigation concerning the nature of the bituminous portions of the various samples of paving, the analyses of which are recorded, but, nevertheless, I formed a strong opinion that the specimen numbered (5) contained a contained a considerable amount of pitch (from gas works), and that the specimens numbered (8), (9), and (10) respectively contained much soft pitch (from gas works). In addition to grit (pure and simple) it is apparent from the analyses that dolomite or dolomitic limestone had been added to the mastics (whatever their natures) used in making the pavings (5) and those numbered (8), (9), and (10). I attributed the excessive brittleness of No. (5) to the hard pitch and the dolomite used in making it. The proportion of grit present in No. (5) paving is very low as compared with that present in the Limmer paving.

If we calculate from the magnesium carbonate the quantity of dolomite introduced, and then deduct the carbonate of calcium thus introduced from the total amount of that constituent we shall be able to ascertain from the residual amount of $CaCO_3$ the proportion of Limmer rock asphalte which may be assumed to have been used in manufacturing each pavement. Thus 9·53 grms. Mg.CO_3 would be accompanied in dolomite with 11·34 $CaCO_3$, and 65·52 less 11 34 = 54·18 grms. $CaCO_3$, corresponding to 64·15 grms. of original Limmer rock. Now, then, these details show the pavement No. (5) to have the following composition—

(5)		Limmer Paving	
Bitumen from Asphalte Rock	8·37	Bitumen from Rock	9·78
Pitch introduced	9·58	Shale Oil & Trinidad Pitch	10·94
$CaCO_3$ from Asphalte Rock	54·18	$CaCO_3$ from Rock	63·29
Dolomite introduced	20·87		
Grit from Rock	1·13	Grit from Rock	1·32
Grit introduced	5·61	Grit introduced	14·18
Undetermined matter from rock	47	—	·54
	100·20		100·05

Or

(5)			Limmer Paving
Native Asphalte Rock	64·14		74·98
Dolomite	20·87		0·00
Grit	5·61	Grit	14·18
Pitch	9·58	Trinidad Pitch & Oil	10·94
	100·20		100·05

In other words supposing the bituminous matters added in making the two pavements to be of equal value for the purpose and that it is immaterial whether dolomite and sand stone, or grit alone be used for binding and giving hardness, then the main difference in the two pavements here compared, is 10 per cent. in the native asphalte rock employed, in favor of the Limmer paving. Again, taking the analysis of number (8) (with which sample (9) is practically identical) and treating the results similarly, we arrive at these estimates :—

Bitumen from Asphalte Rock	8·59
Soft Pitch added	10·87
$CaCO_3$ from Rock	55·64
Dolomite added	4·06
Grit from Rock	1·16
Added Grit	19·68
Undetermined from Rock	·48
	100·48

Or

(8)		Limmer Paving
Asphalte Rock	65·87	74·93
Dolomite	4·06	0·00
Grit	19·68	14·18
Soft Pitch	10 87	10·94
	100·48	100·05

Then as regards number (10) we have :—

Bitumen from Asphalte Rock	6·45
Soft Pitch added	11·48
$CaCO_3$ from Rock	41·79
Dolomite added	7·58
Grit from Rock	·87
Grit added	31·55
Undetermined from Rock	·36
	100·08

Or

(10)		Limmer Paving.
Asphalte Rock	49·47	74·93
Dolomite	7·58	0·00
Grit	31·55	14·18
Soft Pitch	11·48	10·94
	100·08	100·05

As regards the quantity of asphalte rock used in these several instances, the analyses speak for themselves.

Applying the same method of treatment to the mastics, it will be seen that the Limmer mastic is composed as follows :—

	(2)
Bitumen from Asphalte Rock	12·09
Trinidad Pitch and Shale Oil	5·11
$CaCO_3$ from Rock	78·24
Grit from Rock	1·63
Added Grit	2·92
Undetermined Matter from Rock	·67
	100 66

Or

Asphalte Rock	92·63
Grit	2·92
Trinidad Pitch, &c.	5·11
	100·66

and that the other mastic (No. (4) of my series) contained—

Bitumen from Rock	10·95
Pitch, &c. added	11·51
$CaCO_3$ from Rock	70·91
Grit from Rock	1·48
Added Grit	4·91
Undetermined Matter from Rock	·61
	100·37

Or

Asphalte Rock	83·95
Grit	4 91
Pitch	11·51
	100·37

Samples (6) and (7) present a considerable difference in composition to the paving (No. 5) actually laid, the difference being, chiefly, that in place of dolomite ordinary limestone or chalk has been employed in compounding them. The use of pure dolomite affords in itself a clue to the proportions of the component parts of the products.[*] But the samples (6) and (7) do not afford this clue. If, however, we assume that the same amount of asphalte rock was employed in their production as in making the paving No. (5), we calculate that 100 parts contain :—

Asphalte Rock	64·14
Limestone or Chalk	22·60
Grit	4·38
Pitch	8·83
	99·95

With the foregoing considerations before us, it will be seen that, if now, the cost prices of the items—native asphalte rock, dolomitic or ordinary limestone, grit, Trinidad pitch, and ordinary pitch be ascertained, it is easy to arrive at a fairly accurate estimate of the relative money values of the several pavings No. (5) and (8), (9), (10), and the sample of Limmer paving, which I employed as my standard. Thus :—

	Limmer Paving.	Paving No. (5).	Paving (8), (9), (10).	
			(8)	(10)
Asphalte Rock	74·93	64·14	65·87	49·47
Dolomite	0·00	20·87	4·06	7·58
Grit used	14·18	5·61	19·68	31·55
Trinidad Pitch & Shale Oil	10·94	Gas Pitch 9·58	Gas Pitch 10·87	11·48

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[*] This view would be favourable to a contractor, who, if he used a dolomitic limestone containing more $CaCO_3$ than pure dolomite, would get the best of my calculation.—C. T. K.

By way of general observations I would remark, in conclusion, that what is styled 'grit' in these analyses was, in the case of the Limmer paving, composed of very minute pebbles and sand; in the case of No. (5), of a dusty siliceous powder; and in the case of (8), (9), (10), it was of the same general nature as that present in Limmer pavement, but not so uniform in quality and very coarse. The analysis of No. (5) was conducted upon an average of three samples, each of which had been partially analysed previously with fairly identical results. Numbers (8), (9), (10) were one and the same paving, but taken from different places, (8) being the analysis of the average sample of three portions, (9) being the analysis of a fourth portion, and (10) being that of a fifth portion.

The good quality of Limmer paving is derived from the comparatively large amount of natural asphalte rock employed, and that in its turn is valuable, on account of the intimate state in which the chalk forming the basis of the rock is naturally associated with the bitumen. Then again, the bitumen, (Trinidad pitch) melted with it for producing the mastic, and subsequently for producing the paving, is of the best quality, and is certainly superior, in my opinion, to hard or soft pitch derived from gas works. The grit being only introduced for binding purposes, I do not attach so much importance to its nature, provided it is of uniform quality and that the proper amount be thoroughly distributed throughout the mass.

Practically therefore it comes to this, that a good paving can be made from a proper proportion of asphalte rock and a good quality of pitch well mixed, whereas an inferior paving results when the proportion of asphalte rock is lessened, and common gas pitch employed in conjunction therewith, making up the deficiency in mineral matter otherwise.

Notwithstanding what has gone before I am of the opinion that highly useful and good wearing paving may be obtained at low prices by the skilful admixture of ordinary earthy rocks, such as chalk, with the proper proportion of suitable bituminous principles.

Contractors should be required to deposit samples with their tenders and these should in all cases be analysed beforehand. There might also be constructed a scale according to which the payment to be made for the accepted paving should be so much per unit of asphalte rock employed in the making of the paving, in those cases in which it may be stipulated that asphalte rock is to be used.

Mr. Hehner inquired if the chalk or carbonate of magnesia had any particular binding virtue, or was it better than sand.

Mr. Kingzett replied that if grit, dolomite and chalk were added respectively to three portions of the same bituminous matter it would be found that the most brittle product was obtained by the use of dolomite, the next from the chalk, and the most elastic from the grit.

Mr. Dyer asked whether the turpentine worked easily. He had had some samples concerning which the use of bisulphide of carbon had been stipulated for.

Mr. Kingzett said the turpentine worked most readily and most satisfactorily. He was not satisfied with the solvent power of bisulphide of carbon.

Mr. Wynter Blyth wondered no mention was made of the temperature at which these samples of asphalte paving melted or softened; he should have thought that was rather an important factor to obtain in connection with the analyses.

Mr. Kingzett said it was not possible to get a definite figure for that temperature—the materials did not admit of obtaining any such result of much value.

Mr. Wigner said he quite agreed with Mr. Kingzett that it was impossible to obtain such a figure. With reference to the analyses of samples No. 8 (20 8 of grit) and No. 9 (20·01 of grit), judging from some samples he had examined, he should have thought these two pavements would have stood well and worn well.

Mr. Kingzett coincided with this latter expression of opinion generally, but pointed out that his own comments were made more particularly with reference to the compositions of the various samples as compared with genuine Limmer paving.

DETECTION OF MAGENTA, ARCHIL, AND CUDBEAR IN WINE.

These colours are not suitable for converting white wine into red, but they can be used for giving wines a faint red tint; for darkening pale red wines, and in making up a factitious bouquet essence which is added to red wines. The most suitable methods for the detection of magenta are those given by Roméi and Falières-Ritter. If a wine coloured with archil and one coloured with cudbear are treated according to Roméi's method, the former gives, with basic lead acetate, a blue, and the latter a fine violet precipitate. The filtrate, if shaken up with amylic alcohol, gives it in either case a red colour. A knowledge of this fact is important, or it may be mistaken for magenta. The behaviour of the amylic alcohol, thus coloured red, with hydrochloric acid and ammonia is characteristic. If the red colour is due to magenta it is destroyed by both these reagents, whilst hydrochloric acid does not decolourize the solutions of archil and cudbear, and ammonia turns their red colour to a purple violet. If the wine is examined according to the Falières-Ritter method in presence of magenta, ether, when shaken up with the wine, previously rendered ammoniacal, remains colourless, whilst if archil or cudbear is present the ether is coloured red. Wartha has made a convenient modification in the Falières-Ritter method by adding ammonia and ether to the concentrated wine while still warm. If the red colour of the wool is due to archil or cudbear it is extracted by hydrochloric acid, which is coloured red. Ammonia turns the colour to a purple violet. König mixed 50 c.c. wine with ammonia in slight excess, and places in the mixture about ½ grm. clean white woollen yarn. The whole is then boiled in a flask until all the alcohol and the excess of ammonia are driven off. The wool taken out of the liquid and purified by washing in water and wringing, is moistened in a test-tube with pure potassa lye at 10 per cent. It is carefully heated till the wool is completely dissolved, and the solution, when cold, is mixed first with half its volume of pure alcohol, upon which is carefully poured the same volume of ether, and the whole is shaken. The stratum of ether decanted off is mixed in a test-tube with a drop of acetic acid. A red colour appears if the slightest trace of magenta is present. The shaking must not be too violent lest an emulsion should be formed. If the wine is coloured with archil, on prolonged heating, after the addition of ammonia, it is decolourized. If it is then let cool and shaken a little, the red colour returns. If the wool is taken out of the hot liquid after the red colour has disappeared and exposed to the air, it takes a red colour. But if it is quickly taken out of the liquid and at once washed, there remains merely a trace of colour in the wool. If these precautions are observed, magenta can be distinguished from archil with certainty according to König's method. As the colouring-matter of archil is not precipitated by baryta and magnesia, but changed to a purple, the baryta method recommended by Pasteur, Balard, and Wurtz, and the magnesia test, are useless. Magenta may, in course of time, be removed by the precipitates formed in the wine. It is therefore necessary to test not merely the clear liquid, but the sediment, if any.—*Dr. B. Haas in Budermann's Centralblatt.*

THE ADULTERATION LAW IN NEW YORK.

The Sanitary Engineer of New York states that the State Board of Health have commenced prosecutions under the new adulteration law by causing the arrest of nine persons for selling cream of tartar which was adulterated with ground gypsum. The complaints were made by Mr. A. L. Colby, as Inspector, and Dr. E. G. Love, as Analyst, for the Board. The accused pleaded "not guilty," but were held in 100 dols. bail each for trial at the Court of Special Sessions. The adulteration in these cases amounted to from 87 to 92 per cent. of terra alba, or ground gypsum. In every case the accused stated that the substance had been purchased for pure cream of tartar, and he did not know that it was adulterated.

LAW REPORTS.

No further part of Bulk must be added to a sample after purchase :—

At Worship Street, in a case in which a vendor of milk was summoned by the sanitary officer of Bethnal Green, Mr. Bushby gave a judgment which is of importance to parish officers and others appointed inspectors under the Food Adulteration Act.—Mr. Moore, solicitor, appeared for the defendant. —The evidence of the inspector showed that the defendant was vending milk in the street at 2½d. per quart, and that he, the officer, purchased a pennyworth, which he divided into three parts, one of which he gave to the defendant, at the same time informing him, in the words of the Act, that he purchased it for analysis by the "Public Analyst." Then he had, apparently because the bottles into which he had divided the milk were not full, and a larger quantity would afford better opportunity for analysis, purchased a ha'porth more, and put it into the bottles. The milk was admitted to be skimmed of its cream. —Mr. Moore took two objections on the facts.—1. That the inspector had not complied with the Act, because he had not stated, "after the purchase was completed" that he had bought the milk for analysis by the Public Analyst. but only stated it after buying the second quantity; and secondly, that if the purchase were completed when the one pennyworth was bought and the inspector had then complied with the Act, he had yet departed from the letter of the Act by adding something to the article purchased. Though, in this instance the something added was part of the same bulk, yet it was added after the purchase.—Mr. Bushby said there had been several judgments under this Act, and judges had not given the officers appointed under it any latitude as to administering it with laxity, but directed that they must follow it strictly. He decided that the purchase was completed when the pennyworth of milk was bought, and that the inspector up to that point had complied with the Act; but the second objection taken by Mr. Moore must hold good, for he (Mr Bushby) was of opinion that the words of the Act were express, and that the inspector had no right to add anything—the purchase being completed—even from the bulk of the article. The summons would therefore be dismissed. Mr. Moore asked for costs. Mr. Bushby refused to grant them, remarking that the defendant was not entitled to a farthing, and might consider himself lucky to escape a conviction.

At the Croydon Petty Sessions, William Sharps, a dairyman, carrying on business at White Horse Road, was summoned by an Inspector for selling milk containing 50 per cent. of added water. The chairman said a person might just as well put his hand in a man's pocket and steal his money as sell adulterated milk. He regretted that a law could not be made rendering it compulsory for a person guilty of such a mean offence to wear a placard on his back notifying the fact that he had been convicted. Such a tradesman was anything but respectable. He fined the defendant 40s. and 9s. costs.

SOCIETY OF PUBLIC ANALYSTS.

Analyses of English Public Water Supplies in December, 1882. All results are expressed in GRAINS PER GALLON.

Description of Sample.	Date when drawn.	Appearance in Two-foot Tube.	Smell when heated to 100° Fahr.	Chlorine in Chlorides.	Phosphoric Acid in Phosphates.	Nitrogen in Nitrates.	Ammonia.	Albuminoid Ammonia.	Oxygen, Absorbed in		Hardness, Clark's Scale, in degrees.		Total Solid Matter, dried at 220° Fahr.	Microscopical Examination of Deposit.	ANALYSTS.
									15 mins. at 80° Fahr.	4 hours at 80° Fahr.	Before Boiling.	After Boiling.			
Kent Co.	Dec. 13	p. blue, clear	none	1·98	none	·42	·0010	·0026	trace	·014	20 0°	5·0°	32·6	satisfactory	Wigner & Harland.
New River	„ 29	clear yell.	none	1·20	trace	·25	·0028	·0028	·018	·067	16·5°	4·0°	23·8		B. Dyer.
East London ..	„ 13	greenish yell.	none	1·31	none	·22	·0020	·0050	·026	·104	17·0°	3·0°	27·4	veg. deb., anim., fibres	Wigner & Harland.
Southwark & Vauxhall ..	„ 16	grnsh. yell. & c.	none	1·30	trace	·12	·0014	·0077	·054	·097	18·0°	5·8°	20·3	none	J. Muter.
West Middlesex	„ 29	str. grnsh. yell.	none	1·02	trace	·13	·0012	·0040	·058	·130	12·5°	4·0°	22·1		O. Hehner.
Grand Junction.	„	pale yell.	none	1·26	trace	·32	·0019	·0066	·021	·072	14·2°	1·1°	20·9		A. Wynter-Blyth.
Lambeth......	„ 16	grnsh. yell. & c.	none	1·40	trace	·11	·0014	·0077	·054	·095	18·0°	5·7°	21·7	none	J. Muter.
Chelsea	„ 23	green brown	none	1·15	trace	·17	·0007	·0100	·049	·077	13·0°	3·5°	21·0		A. Dupré.
Birmingham ..	„ 6	c. greenish	none	1·26	trace	·20	·0021		·011	·022	12·6°	7·4°	20·6	none	A. Hill.
Bristol........	„ 5	pale green	none	·57	none	·09	none	·0020	·028	·039	14·8°	2 2°	23·6	algæ, sand	F. W. Stoddart.
Brighton......	„ 8	c. pale blue	none	2·48	none	·33	·0033	·0022	·008	·020	13·0°	3·5°	23·6	veg. debris, anim.	Wigner & Harland.
Cambridge	„ 21	c. pale blue	none	1·40	trace	·37	none	·0013	none	·038	17·0°	5·0°	24·8	satisfactory	J. West Knights.
Exeter........	„ 5	f. b. yellow	none	·91	trace	·30	·0007	0049	·012	·038	2·5°	2·5°	5·6	none	F. P. Perkins.
Hastings and St. Leonards	„ 12	greenish	none	4·70	trace	·14	·0035	·0035	·002	·010	8·0°	5·0°	22·1	satisfactory	H. F. Cheshire.
Hereford......	„ 9	c. white	none	·25	none	none	·0002	·0015	·001	·006	5·0°	2·5°	4·2	satisfactory	G. T. Stephens.
Maidstone—															
Wtr. Company	„ 14	pale green	none	2·40	trace	·57		·0021	·022	·028	17·5°	7·5°	31·5		M. A. Adams.
Public Conduit	„ 14	p. grnsh. blue	none	2·30	trace	·58		·0035	·012	·017	18·0°	7·5°	32·8		M. A. Adams.
Manchester ..	„ 29	s. turb., f. yell.	none	·73	none	none	·0023	·0057	·054	·109	1·8°	1·8°	5·1	no fungus or anim. life	W. Thomson.
Northwich	„ 20	greenish yell.	none	2·50	trace	·97	·0007	·0015	·015	·028	11·0°	7·5°	18·0	veg. deb., diatoms	C. M. Blades.
Norwich	„ 11	p. green yell.	none	1·90		·10	traces	·0100	·068	·172	11·7°	3 9°	13·2		W. G. Crook.
Portsmouth ..	„ 12	clear	none	1·20	trace	·23	trace	·0052			13·0°	2·0°	18·5	veg. matter	W. J. Sykes.
Rugby........	„ 26	f. turb.	none	1·26	h. trace	·009	·0100	·0150	·027	·072	12·0°	8·5°	17 2	veg. deb., anim.	A. P. Smith.
Worcester	„ 17	pale yell.	none	1·75	trace	·21	none	·0078	·018	·148	14·3°	6·8°	18·9	veg. deb.	W. E. Porter.

Abbreviations:—c., clear; f., faint; h., heavy; p., pale; v. h., very heavy; v.s., very slight.

RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

No. 1882	Name of Patentee.	Title of Patent.	Price
1714	J. Brockie	Electric Arc Lamps	6d.
1752	W. Weldon	Manufacture of Sulphuric Acid	4d.
1773	Ditto	Manufacture of Sulphides of Soda and Potassium	4d.
1803	A. R. Leask	Manufacturing Incandescent Lamps	6d.
1823	A. S. Church	Electric Lamps	6d.
1866	F. M. Lyte	Purification and Refining of Raw Spirits	4d.
1867	A. B. Brown	Electric Arc Lamps	6d.
1875	D. G. Fitzgerald & C. H. W. Biggs	Secondary Batteries	6d.
1884	W. R. Lake	Separating Metals and Metalloids from their Ores	4d.
1895	P. M. Justice	Electric Lighting and Incandescent Lamps	6d.
1901	A. R. Bennett	Voltaic Batteries	4d.
1903	T. Denne & J. J. Mason	Manufacture of Extract or Essence of Malt	4d.
1915	W. T. Whiteman	Electric Lamps	6d.
1919	J. Lea	Electric Arc Lamps	6d.
1940	W. R. Lake	Crystallized Hydrochlorate of Alumina	4d.
1946	C. V. Boys	Secondary Batteries	6d.
1956	T. J. Handford	Electric Batteries	8d.
1989	J. B. Rogers	Accumulating and Storing Electric Currents	6d.
2014	J. T. Armstrong	Treating Rice for Manufacture of Starch	4d.
2020	J. C. Asten	Obtaining Electric Light	2d.
2025	W. R. Lake	Manufacture of Sugar	2d.
2037	A. L. Jousselin	Manufacture of Electric Incandescent Lights in the Vacuum	2d.
2065	C. H. Cathcart & C. B. Cole	Secondary Battery	4d.
2072	T. J. Handford	Electric Lights	6d.
2110	S. Pitt	Manufacture of Carbonate of Soda by Ammonia	4d.
2136	J. Rapieff	Incandescent Lamps	4d.
2144	J. H. Johnson	Electric Lamps	6d.
2156	H. Lea	Incandescent Electric Lamps	6d.
2193	W. Brookes	Manufacture of Nitrosulphuric Acid	2d.
2213	A. M. Clark	Unhairing Hides and Skins	4d.
2233	J. M. Stuart	Electric Lamps	4d.
2234	C. Scheibler	Separating Sugar from Molasses and Syrups	4d.
2245	T. Varley & H. B. Greenwood	Apparatus for Measuring Electric Currents	6d.
2263	A. Tribe	Secondary Batteries	4d.
2286	R. Kennedy	Electric Lamps	2d.
2298	E. L. Voice	Ditto	6d.
2345	S. H. Emmens	Incandescent Electric Lamps	6d.
2370	J. Brockie	Electric Arc Lamps	8d.
2381	J. Pitkin	Secondary Batteries	6d.
2403	H. H. Lake	Electric Accumulators or Secondary Batteries	2d.
2425	J. J. Barrier & De Lavernade	Incandescent Electric Lamps	6d.
2432	C. G. Andre	Ditto, Ditto.	6d.
2449	F. H. Allan	Treating Spent Lyes of Soap Works	2d.
2559	R. H. Brandon	Treatment of Fatty Substances	6d.
3046	R. Barker	Abstracting Gold and Silver from their Ores	6d.
3795	W. R. Lake	Electric Lamps	6d.
4034	W. R. Lake	Manufacture of Starch, Grape Sugar, &c.	10d.

BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; Journal of Applied Science; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Praticien; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York. The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record, The Canada Lancet; Gas and Water Engineering; The Grocers' Gazette; Columbia School of Mines Quarterly Magazine London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Brewer, Distiller, and Wine Manufacturer (Churchills).

THE ANALYST.

FEBRUARY, 1883.

SOCIETY OF PUBLIC ANALYSTS.

The Annual Meeting of this Society was held at Burlington House on the 17th January, Dr. Muter in the chair.

The minutes of the previous meeting were read and confirmed.

The Chairman read the following letter from the retiring President, Mr. Heisch:—

79, Mark Lane. 17*th Jan.*, 1883.

Gentlemen,

On resigning into your hands the office to which you did me the honour of electing me two years since, my first duty is to express to you my unfeigned regret that during the last year the state of my health has been such as to prevent me, not only from working for the benefit of the Society in the manner I could have wished, but even from attending its meetings. The same circumstance must be my excuse for not being with you this evening, and also for not being able to address you even on paper at any length.

I am glad to be able to congratulate you on the continued prosperity of our Society and the continued usefulness of its work, as testified by the papers which have appeared in The Analyst. While, however, we have much cause for congratulation, we have also cause for unfeigned sorrow, in the severe illness of our esteemed secretary, Mr. Maxwell Lyte, an illness which we have too much reason to fear will prevent his ever being with us again. Those who only knew him at our Society will miss his genial face and manner, while those who, like myself, knew him more intimately, mourn the loss of an estimable man and a kind friend. For an account of the work done by the Society, I must, under the circumstances, refer you to the Council's report. I have to thank you one and all for the uniform courtesy with which you have treated me during my term of office, and for the indulgence shown to my numerous shortcomings. I cannot conclude without expressing my satisfaction that the gentleman proposed as my successor will at last be placed in the position to which the long and eminent services he has done the Society so well entitle him. Heartily wishing the Society prosperity under his presidency, and trusting ere long to meet you with renewed strength,

I remain, Gentlemen, yours most truly,

CHAS. HEISCH.

Dr. Dupré, in proposing a vote of thanks to the retiring President for his services during the past year, said they were all very sorry to know of the cause that kept him out of the chair that evening, but he had been very seriously ill for several months. Mr. Heisch was one of the oldest chemists in London, and in fact was one of the original members of the Chemical Society, of whom there were only three or four now living. His age and the work he had done fully entitled him to be elected as President, and he (Dr. Dupré), had pleasure in moving a vote of thanks for his services.

Mr. Dyer seconded the motion, which was carried unanimously.

The Chairman moved a vote of thanks to the Chemical Society for the use of their rooms during the past year.

Mr. Wynter Blyth proposed a vote of thanks to the Hon. Secretaries, and said that for the first time in the history of the Society that vote which they had always passed with such pleasure had a note of sorrow in it. They all condoled with Mr. Lyte in his long illness, and he but expressed the feelings of the Society when he hoped that in a little time he would be restored to them again. He did not suppose Mr. Lyte had been able to do much work during the year as a Secretary, so that it had fallen chiefly upon Mr. Wigner. He hoped they would all pass that vote in the most cordial manner.

Dr. Bostock Hill having seconded the motion, it was carried unanimously.

Mr. Ashby and Mr. West-Knights were appointed Scrutineers to examine the voting papers, and they reported that the following were duly elected as Officers and Council for the ensuing year.

President.

G. W. Wigner, F.C.S., F.I.C.

Vice-Presidents.

C. Heisch, F.C.S., F.I.C.
A. Hill, M.D., F.C.S., F.I.C.
C. A. Cameron, M.D., F.R.C.S., F.I.C.

Treasurer.

C. W. Heaton, F.C.S., F.I.C.

Hon. Secretaries.

B. Dyer, F.C S., F.I.C.
O. Hehner, F.C.S., F.I.C.

Other Members of Council.

M. A. Adams, F.R.C.S., F.C.S.
A. H. Allen, F.C.S., F.I.C.
A. Ashby, M.B. Lond., F.R.C.S.
A. Dupre, Ph D., F.R.S., F.C.S., F.I.C.
C. T. Kingzett, F.C.S., F.I.C.
F. Maxwell Lyte, F.C.S., F.I.C.
J. Muter, Ph.D., M.A., F.C.S., F.I.C.
P. Vieth, Ph.D., F.C.S.

The names of those Members of Council whose term of office has not yet expired, and who, consequently, do not retire this year, are—

A. Wynter Blyth, M.R.C.S., F.C.S.
A. Bostock Hill, M.D., F.C.S., F.I.C.
T. Jamieson, F.C.S., F.I.C.
G. Jarmain, F.C.S., F.I.C.

Dr. Muter then vacated the chair, which was thereupon taken by Mr. Wigner.

Mr. B. Dyer and Mr. O. Hehner took their seats as Honorary Secretaries to the Society.

Mr. Wigner, having thanked the Society for electing him to that position, delivered the following address:—

It has been the custom in this Society ever since its foundation, for the outgoing President to make a few remarks summarising what has taken place during the previous year. This custom has unavoidably been broken through on the present occasion, owing to the absence of our late President, Mr. Heisch, through illness, as explained in his letter just read. I am sure you will join with me in regretting the cause of Mr. Heisch's absence, as also the fact that through this the duty of summarising the work has fallen upon me, as President for the ensuing year.

As regards the state of our Society, we have elected during the year 10 new members and 2 new associates. We have lost by death 1 member, and by resignation 1 member and 1 associate, making our total membership at the present time 123 members and 19 associates. We are therefore gaining in numbers as well, I hope, as in the influence which as a Society we are able to exert on matters within our own special sphere.

The member whom we have lost by death is Mr. R. G. Fraser, of Nova Scotia. He was of course but little known in this country, but on the other side of the Atlantic his name was well known, and he appears to have done a considerable amount of useful work, especially in connection with the passing of the Adulteration Acts in Canada, and the systematic adoption of a scale of limits and standards, which were in almost every respect identical with those fixed by us here.

As a Society, we are in a somewhat stronger position financially than we were this time last year. We close the year as we have always previously done, without any liability, and have an increased balance at the bankers.

It is usual to judge of the work done by a society by the number of papers submitted to it and printed. In our case we have had during the past year 30 original communications, several of which have been not only of considerable interest, but of permanent value.

For my own part I do not think that the important work which the Society has done is to be at all judged by such a test as this. I think that but for the action taken by us as a body in urging on an uniform systematic mode of analyses of samples of food, discredit would have been brought upon Public Analysts generally by the lack of uniformity, and by the fact that in numerous cases one analyst would have been brought to give evidence against another in order to show a variation of one or two per cent. in any given sample.

Our co-operation one with another, and our influence as a Society, has greatly checked this evil, and while the good result may to some extent have been attained at the cost of making the standards or limits rather lower than in the opinion of some of us they ought to have been, yet that cost has been but a trivial one compared with the gain.

The issue of this month's number of The Analyst completed the second year of the systematic analyses of the principal water supplies. During that time nearly one thousand analyses were made and published, and the Council felt that the time had arrived for the Society to discontinue the work, and to leave it for those water companies or corporations who desire to see it extended to make any arrangements they choose. It is, however, as well to put it on record that, as far as I know, not one analysis out of the one thousand has been paid for—they were, in every sense of the word, independent analyses.

By the result of the ballot this evening I have vacated the post of joint hon. secretary, which I have held since the formation of the Society. For obvious reasons I do not go at any length into what has been done while I have been in that position. One thing, however, is clear, and it should be well borne in mind, that it was entirely owing to the exertions of this Society that the Sale of Food and Drugs Act was passed in such a form as to be capable of being worked at all, and that had the whole of the recommendations which were suggested by the Society been adopted, we should have been spared the occasional failure of prosecutions on technical grounds, and from the general disgrace that results from the fact that, notwithstanding the existence of such an Act, there is hardly any place in the world where (at least) milk adulteration is so prevalent as in London itself.

The Scrutineers reported that Mr. A. P. Stokes, Public Analyst for Paddington, &c., had been duly elected a Member of the Society.

Mr. J. G. Ross, Assistant to Dr. Drinkwater, of Edinburgh, was proposed as an Associate.

Mr. Hehner read a paper "On the Analysis of Bees' Wax—Part I., Yellow Wax," and exhibited very numerous specimens of wax and its adulterants.*

The members and several friends afterwards adjourned to the Criterion, Piccadilly, where the Annual Dinner was held, and a very enjoyable evening spent by those present.

The next Meeting of the Society will be held at Burlington House, on Wednesday, the 14th February.

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* Owing to the length of this paper we are compelled to hold over much other interesting matter, especially Dr. Hogg's paper, "On the Work Done by the Paris Municipal Laboratory."

ON THE ANALYSIS OF BEES' WAX.

PART I.—YELLOW WAX.

By Otto Hehner, F.C.S., F.I.C.

Read before the Society of Public Analysts on the 17th January, 1883.

Analysts who have occasion to enquire into the subject of wax analysis cannot fail to be struck with the fact, that while very numerous "tests" for the purity or otherwise of wax have been published, no *rational* method of wax analysis is in existence: that is to say, no method founded upon the long-known chemical composition of that substance. As was the case, until recently, with fats, the complicated nature of the components seems to have deterred chemists from attacking the subject in a scientific manner. Whilst a certain value cannot be denied to many of the tests to which I have referred, the indications which they yield are most vague, and certainly are quite incapable of giving *quantitative* results. A special and solitary exception must be made in the case of the research of F. Becker (*Corr. Bl. d. Vereins Analyt. Chem.*, 2; 57). This chemist examined a few samples of wax precisely according to Kottsdorfer's method of butter titration, expressing the results in percentages of KHO used. He showed that there existed a notable difference in the neutralising capacity of wax and a number of possible wax substitutes.

In *Philosoph. Transactions*, 1848, Sir Benjamin Brodie demonstrated that bees' wax mainly consisted of *cerotic acid* $C_{27}H_{57}O_2$, *myricine* or *palmitate of myricyle*, $C_{16}H_{31}O$, $C_{30}H_{61}O$, and a small quantity of a fatty substance resembling margarine. To this fatty substance Lewy (Compt. rend. XX) gave the name *ceroleine*, although he did not much to elucidate its nature.

Brodie determined the amount of cerotic acid in a sample of Surrey wax by precipitating the alcoholic solution of the sample by an alcoholic solution of lead acetate, washing the precipitate with alcohol and ether, and calculating from it the amount of cerotic acid. He thus obtained 22 per cent. From a sample of Ceylon wax he did not, however, get any cerotic acid at all. According to John, Buchholz, and Brandes, no less than 90 per cent. of the wax are cerotic acid, Boudel and Boissenot stating the amount at 70 pe cent. Hess found only 10 per cent. Lewy states the percentage of ceroleine to be about 4 to 5.

The above include the whole of the statements which I have been able to trace as to the quantitative composition of bees' wax. It will be allowed that they are far from satisfactory.

I imagined that it should be possible to determine alkalimetrically in alcoholic solution the percentage of cerotic acid, and by saponification also that of myricine, quite analogous to the well-known proceeding of Kottsdorfer. When I first took up this subject the titration of free fatty acid in presence of fat was yet unknown, but in the meantime a great number of chemists have published methods effecting this object. I made some experiments with known mixtures of palmitic acid and tallow, and found that the acid could with the greatest ease be titrated, phenolphthalein being the indicator, and that the amount of fat could also be obtained by boiling with an excess of alcoholic potash and titrating back with standard sulphuric acid. A mixture made of 48·49 per cent. of palmitic acid and 51·51 per cent. of tallow yielded 48·83 per cent. and 51·17 per cent. respectively, the neutralising capacity of the two substances having been separately determined. It is needless, however, for me to enlarge upon these preliminary experiments, since it can be considered to be fully established by others, that fatty acids and fats can thus be readily estimated.

In the case of wax, however, several difficulties present themselves. The first consists in the extraordinary magnitude of the molecular weights of both cerotic acid and myricine the former being 410, the latter no less than 676. Each cubic centimetre of normal alkali, therefore, would neutralise as much as ·41 of cerotic acid, and decompose ·676 grm. of myricine. It was obvious that the titrations had, under these circumstances, to be made with the greatest possible care—a difficulty still enhanced by the dark colour of some of the exotic samples of wax, which somewhat obscured the phenolphthalein indication. A further obstacle was found in the difficulty with which myricine saponifies, and a number of experiments had to be made with a view to ascertain whether this saponification—which in the case of wax has hitherto been affected with fusing potash—could be completed at all in the dilute solutions rendered necessary in quantitative working. The most serious consideration was, however, the supply of really genuine wax. It would naturally be imagined, that if honeycomb were purchased as it comes out of the hive, and oneself separated from it in the usual manner the wax constituting the cell walls, the product would be genuine beyond a doubt. But this is not so. Very many bee-keepers suspend in the hives sheets of wax stamped on both sides with hexagons, to induce the bees to utilise the hexagonal ridges as "foundations" for the cells, thus ensuring the regularity of the comb. These foundations are obtained from certain dealers, some of whom warrant them to be composed of genuine wax. I have no doubt that genuine wax foundations are to be had, but the two samples which I obtained were *mixtures* in spite of the warranty, as will be seen from results stated further on. Pure wax does not appear to be quite so plastic as certain mixtures: this may be one reason for their compound nature; but I suspect that since wax is dear, and fats and paraffin are cheap, the chief inducement is not of an entirely unselfish character. As for 20 lbs. of honey a hive only yields one lb. of wax, it is also intelligible why some bee-keepers are very liberal with the supply of "foundation" to the bees. Although generally a comb into which "foundation" has entered can be distinguished from the more irregular pure comb, and although I have taken all possible care to exclude suspicious samples, I am not at all certain that the whole of the samples which I believed to be unmixed were absolutely pure and free from admixture.

The mode of procedure upon which I finally fixed is as follows:—Alcoholic potash solution is made from pure potash and from spirit which has been distilled from caustic alkali. Each c.c. should correspond to from ·3 to ·4 of normal acid. Two or three standardising experiments must be made, and the average taken. I reject all figures if they differ more than ·02 c.c., calculated for 10 c.c. of standard acid. From 3 to 5 grammes of the wax are weighed on a watch-glass, transferred to a flask holding about 400 c.c., and heated with about 50 c.c. of methylated spirit distilled from alkali. When the wax is perfectly liquefied, alcoholic phenolphthalein solution is added in not too small amount. The phenolphthalein solution must not be acid, as it generally is, but must be rendered pink by a few drops of alkali. The alcoholic potash solution is then added drop by drop, the mixture being kept well agitated until the pink colour is permanent. The volume is read off, and an excess of the alcoholic potash solution is run into the flask, 50 c.c. being the quantity I generally use. The whole is then *briskly* boiled under a reflux condenser, for one hour. If any particle of wax hang above the level of the fluid on the sides of the flask, shake well from time to time. After one hour the solution should be clear, or very nearly so. The excess of potash is then titrated back with standard sulphuric acid, the fluid being kept boiling From the data thus obtained the free acid—calculated as cerotic acid, and the saponifiable substance—calculated as myricine, are obtained.

The following are the results of samples either fused from comb by myself or obtained from bee-keepers direct :—

1.—HERTFORDSHIRE WAX.

3·7417 grm. used 2·82 c.c. KHO (10 c.c. = 4·64 N.S.*) to neutralise the free acid.

Total KHO added 49·96 c.c., titrated back with 16·97 c.c. N.S. Hence cerotic acid ·5371 grm. or 14·35 per cent., and myricine 3·3124 grm. or 88·55 per cent Total, 102·90.

2.—HERTFORDSHIRE

3·7123 grm. used for acidity 2·90 c.c. KHO (strength as above), corresponding to ·5517 grm. cerotic acid.

Total alkali added 52·5 c.c., titrated back with 18·29 c.c. n. H_2SO_4. Hence used for saponification 4·72 N.S., equal to 3·1907 grms. myricine. Cerotic acid 14·86 per cent., myricine 85·95 per cent. Total, 100·81.

3.—HERTFORDSHIRE.

3·2569 grm. used for cerotic acid 3·00 c.c. alc. KHO (10 c.c. = 3·918 c.c. N.S), corresponding to ·4819 grm. or 14·79 per cent. cerotic acid.

Total solution used 50·96 c.c. = 19·97 c.c. N.S. Titrated back with 14·56 c.c. n. H_2SO_4 = 4·23 c.c. used for saponification, indicating 2·8595 grm. or 87·76 per cent. myricine. Total, 102·55 per cent.

4.—SURREY.

Not quite pure, but quantity too small to allow of clarification.

3·0490 grm. used 2·70 c.c. alc. KHO (10 c.c. = 3·615 c.c. n. acid) for neutralisation = ·98 c.c. N.S. = ·4030 grm. or 13·22 per cent. cerotic acid.

Total alc. KHO used 50·0 c.c. = 18·20 c.c. N.S Titrated back with 13·34 c.c. n. acid : this gives 3·88 c.c for myricine = 2·6229 grm. or 86·02 per cent. myricine. Total, 99·24 per cent.

5.—LINCOLNSHIRE.

4·4012 grm. used for cerotic acid 4·05 c.c. alc. KHO = 1·455 c.c. N.S. = ·5965 grm. or 13·56 per cent. cerotic acid.

Total added 50 c.c. alc. KHO = 17·96 c.c. N.S. Titrated back with 10·77 c.c. n. H_2SO_4. Hence 5·74 c.c. used for saponifying myricine, corresponding to 3·8802 grm. or 88·16 per cent. myricine. Total, 101·72.

6.—BUCKINGHAM

3·2972 grm. gave ·483 grm. or 14·64 per cent. cerotic acid and 87·10 per cent. myricine. (The details of titration have been lost).

7.—BUCKINGHAM.

3·7527 grm. used 3·89 c.c. alc KHO for cerotic acid (10 c.c. = 3·696 c.c. N.S.) = 1·437 c.c. N.S. = ·5894 grm. or 15·71 per cent. cerotic acid.

Total taken, 50 c.c. alc. KHO = 18·48 c.c. n. acid. Titrated back with 12·10 c.c. n. acid = 4·942 c.c. used for myricine = 3·3408 grm. or 89·02 per cent. Total, 104·73 per cent.

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* N.S = Normal Solution

8.—HERTFORDSHIRE.

3·8979 grm. used for cerotic acid 3·97 c.c. alc. KHO (10 c.c. = 3·71 c.c. n. acid) = 1·428 c.c. N.S. = ·5855 grm. or 15·02 per cent. cerotic acid.

Total alcoholic KHO taken 50·0 c.c. = 18·55 c.c. n. acid. Titrated back with 12·00 c.c. acid. Hence 5·122 c.c. used for myricine = 3·6425 grm. or 88·83 per cent. Total, 103·85 per cent.

9.—NEW FOREST.

4·0430 grm. used 2·30 c.c. alc. KHO (10 c.c. = 6·417 c.c. n. acid) = 1·476 c.c. N.S. = ·6052 grm. or 14·96 per cent. cerotic acid.

Total alkali taken 30 c.c. = 19·251 c.c. N.S. Titrated back with 12·40 c.c. n. acid. Hence used for myricine 5·375 c.c. = 3·6335 grm. or 89·87 per cent. Total, 104·83 per cent.

10.—LINCOLNSHIRE.

Made from comb containing "foundation."

3·4210 grm. used 3·60 c.c. alc. KHO (10 c.c. = 3·593 c.c. N.S.) = 1·293 c.c. N.S., or ·5301 grm. or 15·49 per cent. cerotic acid.

Total added 50·95 c.c. alc. KHO = 18·31 c.c. N.S. Titrated back with 12·36 c.c. N.S. Hence 4·66 c.c. N.S. used for myricine = 3·1502 grm. or 92·08 per cent. Total, 107·57 per cent.

The following samples were obtained from first-class druggists and merchants, and not fused down by myself:—

11.

3·7727 gms. used 3·66 c.c. alc. KHO for cerotic acid (10 c.c. = 3·68 c.c. N.S.) = 1·347 c.c. N.S. = ·5523 grm. or 14·64 per cent. cerotic acid.

Total alc. KHO taken 50 c.c. = 18·40 c.c. n. acid. Titrated back with 12·17 c.c. N.S. Hence 4·883 c.c. used for saponification of myricine, corresponding to 3·3009 grm. or 87·49 per cent. myricine. Total, 102·13 per cent.

12.

2·9953 grm. used 3·00 c.c. alc. KHO = 1·104 c.c. N.S. = ·4526 grm. or 15·11 per cent. cerotic acid.

Total alc. KHO taken 50 c.c. = 18·40 c.c. N.S. Titrated back with 13·35 c.c. Hence 3·946 c.c. used for myricine = 2·6674 grm. or 89·05 per cent. Total, 104·16 per cent.

13.

3·1626 grm. used 2·75 c.c. alc. KHO (10 c.c. = 3·681 c.c. n. acid) = 1·012 c.c. N.S., or ·4149 grm. or 13·12 per cent. cerotic acid.

Total alc. KHO taken 50 c.c. = 18·405 c.c. N.S. Titrated back with 13·26 c.c. n. acid. Hence 4·133 c.c. N.S. used for myricine = 2·7939 grm. or 88·66 per cent. Total, 101·78 per cent.

14.

4·4360 grm. used 5·75 c.c. alc. KHO (10 c.c. = 2·995 c.c. n. acid) = 1·722 c.c. N.S. or ·7058 grm. cerotic acid = 15·91 per cent.

Total taken 50 c.c. = 14·975 c.c. N.S. Titrated back with 7·53 c.c. n. acid. Hence 5·723 c.c. used for saponification of myricine = 3·8687 grm. or 87·21 per cent. of myricine. Total, 103·12 per cent.

15.

4·5972 grm. used 4·55 c.c. alc. KHO = 1·363 c.c. N.S. = ·5585 grm. or 12·15 per cent. cerotic acid.

Total solution taken 50 c.c. alc. KHO = 14·975 c.c. N.S. Titrated back with 7·52 c.c. n. acid. Hence 6·092 c.c. used for myricine, corresponding to 4·1182 grm. or 89·58 per cent. of myricine. Total, 101·73 per cent.

16.

4·2222 grm. used 4·73 cc. alc. KHO = 1·417 c.c. N.S. = ·58097 grm. or 13·76 per cent. cerotic acid.

Total taken 50 c.c. alc. KHO = 14·975 c.c. N.S. Titrated back with 8·08 c.c. N.S. Hence 5·478 c.c. used for myricine = 3·7031 grm. or 87·70 per cent. myricine. Total, 101·46 per cent.

17.

4·3222 grm. used 5·21 c.c. alc. KHO (10 c.c. = 2·70 c.c. N.S.) = 1·423 c.c. N.S., corresponding to ·5834 grm. or 13·49 per cent. cerotic acid.

Total alc. KHO taken 51 c.c. = 13·77 c.c. N.S. Titrated back with 6·78 c.c. n. acid. Hence 5·567 c.c. used for myricine = 3·7633 grm. or 87·76 per cent. Total, 101·25 per cent.

18.

4·2082 grm. used 5·48 c.c. alc. KHO (10 c.c. = 2·675 c.c. N.S.) = 1·466 c.c. N.S., or ·6011 grm. or 14·28 per cent. cerotic acid.

Total alc. KHO taken 50 c.c. = 13·375 c.c. N.S. Titrated back with 6·51 c.c. n. acid. Hence for myricine 5·399 c.c. = 3·6497 grm. or 86·73 per cent. myricine. Total, 101·01 per cent.

The eighteen samples, the results of which are given above, are all English. The following are foreign waxes, obtained direct from the importers :—

19.—UNITED STATES.—BROWN WAX.

2·9135 grm. used 2·91 c.c. alc. KHO (10 c.c. 3·701 c.c. n. acid) = 1·077 c.c. N.S. = ·4416 grm. or 15·16 per cent. cerotic acid.

Total alkali added 49·97 c.c. = 18·491 c.c. N.S. Titrated back with 13·62 c.c. N.S. Hence for myricine 3·797 c.c. = 2·5668 grm. or 88·09 per cent. myricine. Total 103·25 per cent.

20.—MADAGASCAR.

4·3301 grm. used 3·87 c.c. alc. KHO, corresponding to 1·432 c.c. N.S. ·5872 grm. or 13·56 per cent. of cerotic acid.

Total alkali added 50·03 c.c. = 18·516 c.c. N.S. Titrated back with 11·44 c.c. Therefore 5·644 c.c. used for saponification, equal to 3·8153 grm. or 88·11 per cent. of myricine. Total, 101·67.

21.—MAURITIUS.—BROWN.

5·1666 grm. took for cerotic acid 5·20 c.c. alc. KHO (10 c.c. = 3·16 c.c. n. acid) or 1·643 c.c. N.S. = ·6736 grm. or 13·04 per cent. cerotic acid.

50 c.c. added for saponification. Titrated back with 7·41 c.c. N.S. Hence myricine took 6·747 c.c. = 4·5609 grm. or 88·28 per cent. Total 101·32 per cent.

22.—MAURITIUS.—DARK BROWN.

3·6639 grm. required 2·18 c.c. alc. KHO = 1·087 c.c. N.S. (10 c.c. = 5·105 $H\,SO_4$). Hence myricine ·4457 grm. or 12·17 per cent.

Total solution taken 40·26 c.c. = 20·553 c.c. n. H_2SO_4. Titrated back with 14·28 c.c. acid. Therefore used for saponification 5·186 c.c. = 3·5057 grm. or 95·68 per cent. myricine. Total, 107·85 per cent.

23.—MAURITIUS.—DARK BROWN.

From same consignment as previous sample, but different in colour.

3·4758 grm. took 3·68 c.c. alc. KHO (10 c.c. = 3·16 c.c. N.S.) = 1·163 c.c. N.S. = ·4768 grm. or 13·72 per cent. cerotic acid.

50 c.c. alc. KHO = 15·80 c.c. N.S. taken. Titrated back with 9·68 c.c. H_2SO_4. Hence used for myricine 4·987 c.c. = 3·3374 grm. or 96·02 per cent. myricine. Total, 109·73 per cent.

24.—MAURITIUS.

3·7777 grm. used 2·47 c.c. alc. KHO (10 c.c. = 5·125 c.c. N.S.) = 1·266 c.c. N.S. = ·5189 grm., or 13·74 per cent. cerotic acid.

Total alkali taken 40·17 c.c. = 20·587 c.c. N.S. Titrated back with 14·01 c.c. n. acid. Hence, for saponification, 5·311 c.c. = 3·5902 grm. or 95·04 per cent. myricine. Total, 108·78 per cent.

25.—MAURITIUS.—Light Brown.

5·2037 grm. took 5·40 c.c. alc. KHO (10 c.c. = 3·16 c.c. N.S.) = 1·706 N.S., or ·6995 grm. 13·11 per cent. cerotic acid.

Total taken 50·9 c.c. KHO = 16·08 c.c. N.S. Titrated back with 7·21 c.c. H_2SO_4. Hence, myricine used 7·131 c.c. 4·8226 grm. or 92·67 per cent. Total 106·11 per cent.

26.—JAMAICA.—Bright Yellow.

Did not saponify perfectly clear.

3·8378 grm. took 1·98 c.c. alc. KHO (10 c.c. 6·377 c.c. N.S.) = 1·263 c.c. N.S. = ·5177 grm., or 13·49 per cent. cerotic acid.

Total alcoholic KHO taken 50 c.c. = 31·885 c.c. N.S. Titrated back with 25·79 c.c. acid. Hence, 4·832 used for myricine 3·266 grm., or 85·12 per cent. Total 98·61 per cent.

27.—JAMAICA.

Did not saponify quite clear.

4·8946 grm. used 5·40 c.c. alc. KHO (10 c.c. = 3·16 c.c. H SO) = 1·706 N.S. = ·6995 grm., or 11·30 per cent. cerotic acid.

Total taken, 50 c.c. = 15·80 c.c. N.S. Titrated back with 7·88 c.c. H_2SO_4. Hence, for myricine used, 6·211 c.c. = 4·1986 grm., or 85·78 per cent. myricine. Total, 100·08 per cent.

28. MOGADORE.

5·4298 grm. took 6·10 c.c. alc. KHO (10 c.c. 2·92 c.c. N.S.) = 1·781 c.c. N.S. = ·7198 grm., or 13·11 per cent. cerotic acid.

Total alkali taken, 50 c.c. = 14·60 N.S. Titrated back with 1·67 c.c. H_2SO_4. Hence, myricine used 7·119 c.c. 4·8327 grm., or 89·00 per cent. Total, 102·11 per cent.

29.—MOGADORE.

3·1366 grm. required for acidity 2·08 c.c. alc. KHO (10 c.c. = 5·125 N.S.) = 1·066 c.c. N.S. = ·4371 grm., or 13·93 per cent. cerotic acid.

Total KHO added, 39·94 c.c. = 20·17 c.c. N.S. Titrated back with 14·65 c.c. N.S. Hence, used for myricine, 4·753 c.c. = 3·2130 grm., or 102·44 c.c. myricine. Total, 116·37 per cent.

30.—MOGADORE.

Very soft, intensely acrid and hot.

3·4854 grm. required 2·16 c.c. alc. KHO = 1·107 c.c. N.S. for acidity, corresponding to ·4539 grm., or 13·02 per cent. cerotic acid.

Alcoholic KHO added 10·36 c.c. = 20·684 c.c. N.S. Titrated back with 13·50 c.c. N.S. Hence, for myricine, 6·077 c.c. = 4·1080 grm., or 117·86 per cent. Total, 130·88 per cent.

31.—GAMBIA.—Dark Brown.

4·3081 grm. took 6·50 c.c. alc. KHO (10 c.c. = 2·675 c.c. N.S.) = 1·739 c.c. N.S. = ·7130 grm., or 16·55 per cent. cerotic acid.

Total alc. KHO taken, 50 c.c. = 18·375 c.c. N.S. Titrated back with 6·30 c.c. N.S. Myricine used 5·336 c.c. = 3·6071 grm., or 83·73 per cent. Total, 100·28 per cent.

32.—MELBOURNE.—Grey Wax.

3·6286 grm. used 1·92 c.c. alc. KHO (10 c.c. = 6·417 c.c. N.S.) = 1·232 c.c. N.S. = ·5051 grm., or 13·92 per cent. cerotic acid.

Alcoholic KHO added, 32 c.c. = 20·53 c.c. N.S. Titrated back with 14·51 c.c. N.S. Used for saponification, 4·79 c.c. = 3·2380 grm., or 89·24 per cent. myricine. Total, 103·16 per cent.

33.—MELBOURNE.—Pale Yellow.

3 2720 grm. took 2·53 c.c. alc. KHO (10 c.c. = 4·16 c.c. N.S.) = 1·052 c.c. N.S. = ·4315 grm., or 13·18 per cent. cerotic acid.

41 c.c. alc. KHO = 17·056 c.c. N.S. taken. Titrated back with 11·76 c.c. N.S. Hence, 4·244 c.c. used for myricine = 2·8619 grm., or 87·47 per cent. Total, 100·65 per cent.

34.—SYDNEY.—Grey Wax.

3·5165 grm. used 2 69 c.c. alc. KHO (10 c.c. = 4·168 c.c. N.S.) = 1·12 c.c. N.S. = ·4592 grm., or 13·06 per cent. cerotic acid.

3·9018 grm. took, for myricine, 5·356 c.c. N.S. = 3·6207 grm., or 92·79 per cent. myricine. Total, 105·78 per cent.

35.—SYDNEY.—Pale Yellow.

3·7613 grm. used 2·90 c.c. alc. KHO = 1·207 c.c. N.S. = ·4919 grm., or 13·16 per cent. cerotic acid.

41 c.c. alc. KHO added = 17·068 c.c. N.S. Titrated back with 10·93 c.c. N.S. Hence, 4·931 c.c. were used for saponification, corresponding to 3·3334 grms., or 88·62 per cent. myricine. Total 101·78 per cent.

These results may be conveniently examined in two divisions; samples 1—18, comprising samples from various English sources; and 19—35, being exotic productions.

If we exclude from Division I., No. 4, fused by myself from the comb, on account of the sample having been palpably impure with suspended matters which could not be separated, the quantity of wax being small; and sample No. 10, having been made from comb containing "foundation," it is at once seen that the figures fluctuated only between comparatively narrow limits. Only one of the samples contained less than 13 per cent. of free acid calculated as cerotic acid, four between 13 and 14, seven between 14 and 15, and four between 15 and 16, *the average amount of cerotic acid being* 14·40 *per cent.* The saponifiable matter, calculated as myricine, was in one case less than 86, in one between 86 and 87, in six between 87 and 88, in four between 88 and 89, and in four between 89 and 89·6, *the average being* 88·09 *per cent.* In all cases is the sum of cerotic acid plus myricine somewhat higher than 100, it reaching on the average 102·49. While these figures conclusively prove that English bees' wax consists almost completely of cerotic acid and of myricine, they also corroborate the existence of a small quantity of a substance of lower molecular weight in wax, probably Lewy's ceroleine.

I thought it possible, that during the prolonged boiling of the alcoholic potash solution some of the alkali might be neutralised by the silica of the glass, the quantity destroyed of course counting in the analysis as myricine, and thus bringing up the totals to upward of 100. But this is not the case, for in a blank experiment not the slightest diminution of strength could be observed after 50 c.c. of alcoholic potash had been kept briskly boiling for one hour.

It must be considered to be established by these results, that the composition of wax is not liable to the enormous variations which the figures quoted in an early part of this paper would lead to infer. On the contrary, *the relation between the amounts of cerotic acid and of myricine is remarkable for its constancy.* The observation of Dumas and Milne-Edwards, who established that the wax is formed by the bees themselves, and is a true animal secretion, are indirectly borne out by my figures, for it seems highly improbable that a product consisting of a mixture of two substances could be obtained of such striking constancy if it were collected ready formed from the plant. The case is very similar to that of milk and butter, secretions which under normal circumstances are also subject to but little fluctuation in composition.

In English wax the proportion of myricine to cerotic acid is 6·117 : 1.

The fluctuations are much more considerable in the case of the exotic samples; but I am very strongly of opinion that, although all allowance must be made for the fact that those foreign samples, coming as they do from all quarters of the globe, are doubtless derived from a great variety of different insects, the fluctuation is due more to man who collected the samples and put them into marketable form than to the insects who produced them. For this belief testifies the observation, that, while some of the samples of Mogadore and Mauritius wax corresponded in composition with English samples, others showed a great increase in the saponifiable matter, calculated as myricine. The soft, smeary Mogadores were obviously mixed with some fat: some of the Mauritius specimens appeared burnt in process of melting out of the comb. And, lastly, it is not a little significant that the market price of the "normal" samples is considerably above that of the specimens which gave excessive totals. I think I am justified to hold, that the analyses of the foreign samples strengthen the conclusions I have drawn from those of English wax. More evidence may be desirable, but this can only be obtained by the analysis of authenticated genuine samples so difficult to obtain. Meanwhile it will be well if I confine my observations as to adulterations of wax and their detection to the home product.

The organic substances, which may be, or have been known to be, used as adulterants of wax, may be conveniently grouped in three classes:—

I., Acid substances; II., Neutral but saponifiable compounds; and,
III., Matters indifferent to alcoholic potash.

The first class embraces the solid fatty acids, mainly palmitic and stearic, and the acids which constitute resin, particularly sylvic acid.

The second group is made up of neutral solid glycerides—viz.: stearine and palmitine—of Japanese wax, spermaceti, and Carnauba wax.

The only representative of the third division, for practical purposes, is paraffin. Solid alcohols of high molecular weight, such as cetylic or myricylic, would also belong to this class; but, being non-marketable, they need hardly be taken into account.

Now it is remarkable, and of the greatest importance to the analyst, that both compounds of which wax is composed possess a higher equivalent weight than any other substances belonging to the fatty acid series occurring in nature.[*] The molecular weight of cerotic acid is 410, that of myricyl palmitate 676. Stearine, indeed, has a molecular weight of 890, but containing the acid group $C_{18}H_{35}O$ three times—its neutralisation-equivalent is only 296·7. In addition to this fact, there are no fatty compounds available for the adulteration of wax possessing a higher number of carbon atoms than stearic acid—$C_{18}H_{36}O_2$. There is, consequently, a very large difference between the molecular weights of cerotic acid, and especially of myricine, and any possible substitutes.

Class I.—Let us imagine, then, that a fatty acid—say stearic—be used with bees' wax. The neutralising power would of course increase; but not only to an extent equal to the quantity added, but much more considerably, for 281 parts of stearic acid will count for as much as 410 parts of cerotic acid; 1 per cent. of stearic acid would, therefore, be reckoned as 1·413 per cent. of cerotic acid; whilst one of palmitic would correspond to 1·601 of cerotic acid. Since neither pure palmitic nor stearic acids are likely to be employed, but mixtures of these acids in variable proportion, I prefer to calculate that *each per cent. of fatty acid, taking the same as* $C_{17}H_{34}O_2$, *is equal to* 1·518 *of cerotic acid.*

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[*] Excepting the fatty acid recently discovered by Mr. Kingzett in cocoa butter.

Whilst by the addition of fatty acid the acidity would thus increase, the proportion of saponifiable matter (myricine) would be decreased in direct proportion to the quantity of fatty acid added. Thus, a mixture of five equal parts of wax and fatty acid would yield 83·10 per cent. of acidity calculated as cerotic acid, and 41·01 per cent. of myricine.

In the case of resin the conditions would be similar, although the differences would be less pronounced. Ordinary colophony mainly consists of sylvic acid, generally assumed to be $C_{20}H_{30}O_2$ (equiv. 302), but from a number of experiments which I made on the neutralising capacity of two ordinary commercial samples, I find its composition more nearly to correspond with the more recent formula $C_{44}H_{64}O_5$, the acid being taken as dobasic (equiv. 336). One grm. of resin neutralised respectively alc. KHO corresponding to 3·038 and 3·046 c.c. normal solution. Hence the total equivalent of the substance is 329.

One per cent. of resin would, therefore, if mixed with wax, be calculated as 1·246 per cent. of cerotic acid, whilst it would depress the myricine, like fatty acids, in exact proportion to its amount.

It need hardly be said, that by titration alone we measure only the total acidity, and do not distinguish between fatty acids or resin, although the amount of depression in the proportion of myricine, in relation to the rising in the acidity, might furnish some indication as to the nature of the adulterant. I have made no experiments in this direction; but if the exact composition of the acid admixture had to be ascertained, no doubt the well-known method of Barfoed, depending upon the difference of the behaviour of fatty and resin soaps with ether-alcohol, would give the information desired.

Class II.—Coming to the second group of possible admixtures—namely, saponifiable, neutral substances—the line of reasoning advanced in the case of Class I. renders it evident that, if any neutral glyceride be added to wax, the percentage of saponifiable substance, calculated as myricine, must increase in a much larger proportion than the actual percentage of fat added. Taking the average between tri-palmitine and tri-stearine (molecular weights 806 and 890 respectively), we find that 282 8 parts of fat neutralise as much alkali on saponification as 676 parts of myricine; or, in other words, 1 *part of fat will count as* 2·391 *parts of myricine.* It will, of course, cause a depression in the amount of cerotic acid directly corresponding to the quantity of admixture.

Japan wax, stated to consist entirely of palmitine, would be indistinguishable from ordinary fats. I thought it well, however, to verify the statements which are made in the text books in reference to the composition of this curious substance.

3·1123 grm. of a pure sample of Japan wax were heated with alcohol. The solution was distinctly acid to phenolphthalein, alcoholic potash solution corresponding to ·756 c.c. N.S. being necessary to produce a pink tint. This corresponds to ·1935 grm., or 6·21 per cent. of palmitic acid. 10·90 c.c. of N.S. were required for complete saponification, corresponding to 2·9295 grm., or 94·12 per cent. palmitine. Total, 100·33 per cent.

3·6334 grm. of another, somewhat yellow, sample, used for total acidity 1·693 c.c. N.S., corresponding to ·4334 grm., or 11·93 per cent. of palmitic acid. For saponification, further 12·356 c.c. N.S. were used, equal to 3·3200 grm., or 91·38 per cent. palmitine. Total, 103·31 per cent.

These results show that Japan wax contains, besides a saponifiable fat, a considerable percentage of free fatty acid. There can be little doubt, from the satisfactory approach to 100 of the sum of both, that the acid, both free and combined, is really palmitic acid.

An addition of Japanese wax to bees' wax would, therefore, amount to addition of both free fatty acid and of fat, and there would be a rise in both cerotic acid and in myricine.

Spermaceti constitutes the link between fats and wax, it being stated to consist mainly of cetyl palmitate, $C_{16}H_{31}O,C_{16}H_{33}O$; but, according to Heintz, it also contains stearic, myristic, cocinic, and cetic acids, and the alcohols with 12, 14, 16, and 18 carbon atoms.

3·4443 grm. of a very fine specimen of spermaceti, treated in the manner described, were found to be quite free from uncombined acid. Alcoholic potash corresponding to 7·97 c.c. N.S. was used for saponification, equal to 3·7776 grm., or 109·68 per cent. cetyl palmitate.

Another specimen was also free from acidity. 4·3510 grm. used for saponification 9·875 per cent. N.S., corresponding to 4·7400 grm., or 108·94 per cent. cetyl palmitate.

A third sample was very slightly acid, the acidity corresponding to ·81 per cent. of palmitic acid. 3·6933 grm. used for saponification—after substraction of the volume neutralised by the free acid—8·475 c.c. of N.S., corresponding to 4·0780 grm., or 110·41 per cent. cetyl palmitate.

It is evident, from these figures, that spermaceti includes a *notable* amount of one or more substances of lower molecular weight than cetyl palmitate. Taking the average of the three analyses, the molecular weight of spermaceti is 437·6, instead of 480, corresponding to cetyl palmitate. Spermaceti lies, therefore, almost exactly in the middle between fat and myricine, the molecular weights being 282·8, 437·6, and 676 respectively.*

Carnauba wax has been but very little studied, and I cannot add much to the small amount of information available. According to Maskelyne, it contains free myricylic alcohol and several other similar alcohols, whilst Berard states it to contain free cerotic acid.

The only specimen I tested showed distinct acidity. 3·6733 grm. neutralised alcoholic potash equal to ·543 c.c. N.S. This would correspond to ·2226 grm. or 6·09 per cent. of free cerotic acid. For saponification 5·032 c.c. N.S. were used, corresponding to 3·4046 grm. or 92·58 per cent. of myricine. Total, 98·67 per cent.

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* The price of spermaceti being equal to that of the best qualities of wax, and superior to that of the lower qualities, renders its employment as a wax adulterant very doubtful. As, on the contrary, wax is not unfrequently mixed with spermaceti in the manufacture of sperm candles, the analyses quoted may here find a place.

As far as its behaviour with alcoholic potash is concerned, Carnauba wax therefore very closely resembles ordinary bees' wax. Its physical properties are, however, so very different, its solidity and hardness being remarkable, that I believe it to contain compounds of higher molecular weight than ordinary wax. In the present state of our knowledge of this curious substance, material for the analytical distinction between it and bees' wax is wanting. The great and somewhat embarrassing similarity in its neutralizing power and that of ordinary wax is, however, a matter of little consequence, as Carnauba could hardly be used by itself as a wax adulterant. It would serve rather for the purpose of hardening samples mixed with fats or other soft substances.

The different substances described in Class II. saponify with different degrees of readiness. Fat, including Japan wax, breaks up very rapidly; next comes spermaceti; Carnauba wax much more slowly, its melting point being higher than the boiling point of the spirit I employed. Ordinary wax is, in this respect, most tenacious of all.

CLASS III.—As to the representative of the third class—inert substances—viz., paraffin, but little need be said. An addition of paraffin depresses both cerotic acid and myricine, their proportion not being altered. If the mixture contains nothing but wax and paraffin the deficiency between the amounts of cerotic acid plus myricine and 100 may be taken as the percentage of paraffin. Its presence cannot well be overlooked during saponification, paraffin being but little soluble in alcohol. It adheres to the sides of the flask in a characteristic manner. The specific gravity of the sample would also be lower than that of the pure wax.

But it is quite easy to imagine mixtures of fatty acids, fat and paraffin, quiet devoid of wax, yet giving on analysis, in the manner proposed, results identical with those yielded by pure wax. Thus a mixture of 9·18 per cent. of fatty acids, 36·81 per cent. of fat, and 53·68 per cent. of paraffin would show on analysis 14·40 per cent. of cerotic acid and 88·09 of myricine.

It becomes necessary, therefore, to estimate the paraffin directly, and not by difference. This purpose may be effected by heating a weighed quantity of wax with from five to ten times its bulk of sulphuric acid to about 180° C. Volumes of sulphurous acid are given off, the fluid frothing and rising considerably. The vessel in which this treatment is accomplished must therefore be *capacious*. After about ten minutes heating the mass becomes almost solid. It is allowed to cool, the acid removed by washing with water; the residue is exhausted with ether, preferably in a Soxhlet tube. The paraffin thus obtained is again treated with a little sulphuric acid, to remove a small quantity of wax which generally escapes destruction during the first charring process. It is again washed free from acid and purified with ether.

Having thus obtained the percentage of paraffin in any wax mixture, the composition of 100 parts of the remainder may be readily calculated, as follows :—

Let A be the percentage in the paraffin free mixture of free acidity, calculated as cerotic acid; B the percentage of saponifiable matter calculated as myricine. Let X be the unknown percentage of cerotic acid, Y of fatty acid, Z of myricine, and W of fat in any mixture containing fatty acid, fat and wax, either separately or all together.

We know that

$$X + 1{\cdot}518\ Y = A. \quad (1)$$

$$Z + 2{\cdot}391\ W = B. \quad (2)$$

$$Z = 6{\cdot}117\ X. \quad (3)$$

$$X + Y + Z + W = 100. \quad (4)$$

From (1) $Y = \frac{A - X}{1{\cdot}518}$

From (3) $Z = 6{\cdot}117\ X$ and from (2) and (3) $W = \frac{B - 6{\cdot}117\ X}{2{\cdot}391}$

Substituting these values of Y, Z and W in equation (4) we get

$$X + \frac{A - X}{1{\cdot}518} + 6{\cdot}117\ X + \frac{B - 6{\cdot}117\ X}{2{\cdot}391} = 100.$$ From this

$$X = \frac{362{\cdot}954 - 2{\cdot}391\ A - 1{\cdot}518\ B}{14{\cdot}151}$$ or

$$X = 25{\cdot}649 - ({\cdot}1689\ A + {\cdot}1073\ B).$$

We would thus obtain the percentage of *cerotic acid*. This, multiplied by 6·117, furnishes the *myricine*, the sum of both being the percentage of *wax* in the mixture.

The real cerotic acid, subtracted from A, and the remainder divided by 1·518 gives the percentage of added *fatty acids.*

The real myricine, subtracted from B, and the remainder divided by 2·391, gives the percentage of *fat.*

We thus obtain the percentage composition of the mixture, apart from any paraffin it may contain. It is then, of course, easy to calculate the percentages obtained upon the total article, including paraffin.

The following analyses of mixtures will show that the above formulæ, based solely upon theoretical considerations, hold good in actual working. Allowance has of course to be made for the fluctuations in the composition of pure wax itself, for the fact that fatty acids are not likely to be mixtures of exactly equivalent parts of stearic acid and palmitic acid, nor fats of stearin and palmitine, as assumed in the formulæ.

The mixtures which I analysed were, in composition, both qualitatively and quantitatively unknown to me. Only after the analyses and calculations were completed were the figures compared with the percentages actually used in the preparation of the test samples. give the results without selection:—

4·2218 grm. of a mixture used 3·91 c.c. alc. KHO (10 c.c. = 3·16 c.c. N.S.) = 1·286 c.c. N.S., corresponding to ·5067 grm., or 12·00 per cent. cerotic acid.

50 c.c. added for total saponification = 15·80 c.c. N.S. Titrated back with 7·40 c.c. Hence, 7·164 c.c. N.S. used for saponification = 4·8429 grm., or 114·72 per cent. myricine.

CALCULATED COMPOSITION.

Cerotic acid	11·30	Wax 80·42
Myricine	69·12	
Fatty acid	·46	Fat 19·58
Fat	19·07	

ACTUAL COMPOSITION.

Wax	79 98
Lard	20·02
	100·00

3·8590 grm. of another mixture used for acidity 2·00 c.c. alc. KHO (10 c.c. = 3·161 c.c. N.S.) = ·633 c.c. N.S., corresponding to ·2595 grm., or 6·72 per cent. cerotic acid.

Total taken, 50 c.c. = 15·82 c.c. N.S. Titrated back with 5·43 c.c. N.S. Hence, used for saponification, 9·757 c.c. = 6·5957 grm., or 170·92 per cent. of myricine.

From these results the following composition is calculated:—

Cerotic acid	6·18	Wax 43 98
Myricine	37·80	
Fatty acid...	·35	Fat 56·03
Fat	55·68	

Actual Composition.

Wax	41·30
Lard	58·70
	100·00

4·3019 grm. used 9·55 alc. KHO = 3·022 c.c. N.S., corresponding to 1·2390 grm., or 28·80 per cent. cerotic acid.

Total alc. KHO taken, 50 c.c. = 15·82 c.c. N.S. Titrated back with 7·94 c.c. N.S Hence, for saponification, 4·858 c.c. N.S. = 3·2840 grm., or 76·34 per cent. myricine.

Calculated Composition.

Cerotic acid ...	12·59	Wax 89·60
Myricine	77·01	
Fatty acid..	10·67	Fatty acid 10·67
Fat	none	

Actual Composition.

Wax	89·66
Palmitic acid	10·34
	100 00

3·3126 grm. of a mixture took 35·52 c.c, alc. KHO = 11·238 c.c. N.S. for neutralisation. Hence 4·6076 grm, or 139·09 per cent. cerotic acid.

60 c.c. alc. KHO taken = 18 984 c.c. Titrated back with 7·27 c.c. N.S. Therefor used for saponification ·476 c.c. N.S. = ·3218 grm. or 9·71 per cent. myricine.

Calculated Composition.

Cerotic acid	1·11	Wax 7·93
Myricine	6·82	
Fatty acid	90·89	Fatty acid 92·10
Fat	1·21	

Actual Composition.

Wax	9·27 per cent.
Fatty acid	90·73
	100 00

3·5662 grm. took 12·70 c.c. alc. KHO = 4·018 c.c. N.S., corresponding to 1·647 grm. or 46·19 per cent. cerotic acid.

Total taken 60 c.c. alc. KHO = 18 984 c.c. N.S. Titrated back with 9·65 c.c. N.S. Hence used for saponification 5·326 c.c. N.S. =3·6004 grm. or 100·96 per cent. myricine.

CALCULATED COMPOSITION.

Cerotic acid	7·01	Wax 49·92
Myricine	42·91	
Fatty acid...	25 81	
Fat	24·28	

ACTUAL COMPOSITION.

Wax	49·68
Fatty acid...	25·42
Fat	24·90
	100·00

All the above mixtures were free from paraffin. In the following mixtures paraffin was on saponification seen to be present.

3·7660 grm. used for acidity 12 59 c.c. alc. KHO = 3·983 c.c. N.S. = 1·6330 grm. or 43·36 per cent. cerotic acid.

Total alkali taken 50 c.c. = 15·82 c.c. N.S. Titrated back with 9·60 c.c. N.S. Hence 2·237 c.c. N.S. used for saponification, corresponding to 1·5122 grm. or 40·15 per cent. myricine.

5·1186 grm. furnished 1·3988 grm. of paraffin. Hence paraffin 27·33 per cent.

The mixture free from paraffin would consequently have shown—Cerotic acid 59·66 per cent., myricine 55·25 per cent.

From these figures the percentage composition of the mixture calculates as follows :—

Cerotic acid	6·90	Wax 49·11
Myricine	42·21	
Fatty acid...	23·55	
Fat	none	
Paraffin	27·33	

ACTUAL COMPOSITION.

Wax	49·67
Fatty acid...	23 80
Fat	*nil.*
Paraffin	26·53
	100·00

3·4219 grm. yielded ·5806 grm., or 16·96 per cent. cerotic acid, and ·7328 grm., or 21·41 per cent. myricine. The mixture contained paraffin, the presence of which was evident both during saponification, and proved by the low sum of the percentages of cerotic acid plus myricine. I did not estimate by direct experiment the percentage of paraffin; but, seeing that the proportion of acidity to myricine was in excess of that obtained in natural wax, I concluded that the mixture consisted of wax, fatty acid, and paraffin. To 21·41 per cent. myricine correspond 3·50 per cent. cerotic acid. Hence—

Wax	24·91 per cent.
Fatty acid	8·86
Paraffin	66·23
	100·00

ACTUAL COMPOSITION.

Wax...	26·01	
Fatty acid	9·16	73·99 paraffin candle.
Paraffin	64·83	
	100·00	

4·2389 grm. of a mixture gave ·6719 grm., or 15·85 per cent. cerotic acid, and 2·3396 grm., or 55·19 per cent. myricine. This calculated like the previous sample gives :—

Cerotic acid ...	9·02	64·21 per cent. wax.
Myricine ...	55·19	
Fatty acids ...	4·48	
Paraffin	31·31	
	100·00	

ACTUAL COMPOSITION.

Wax	66·67	
Fatty acid ...	4·13	33·33 per cent. paraffin candle.
Paraffin	29·20	

It must be remarked, in reference to the two last analyses, that it is not legitimate generally to take the percentage of paraffin by difference, for in the simultaneous presence of both fat and fatty acids the saponifiable matter could not simply be taken to be myricine.

I hope, then, to be justified in believing that I have established, by crucial and careful experiments, that, both the line of argument adopted, and the formulæ developed by me, are substantially correct, my researches furnishing a rapid and most simple method for the analysis of yellow wax, the results obtained giving at once information as to the *nature* of the additions and their *quantities.*

Physical indications and especially estimations of specific gravity should not, however, be disregarded. They may both corroborate the analytical results and lead to the detection of substances liable to be overlooked.

Thus, while paraffin and fat are lighter than wax, fatty acids are somewhat, and resin is much, heavier; an abnormally low specific gravity would cause us at once to look after the former, and unusually high gravity after the latter. In the case of resin such an indication is especially valuable, as without a hint its presence would be liable to be overlooked and its quantity to be stated in terms of fatty acid.

The following specific gravities relate to samples previously referred to in this paper:—

Wax.	
Sample 1	·9656
,, 2	·9656
,, 3	·9663
,, 5	·9655
,, 7	·9671
,, 8	·9673
,, 12	·9655
,, 16	·9675
,, 25	·9672
,, 26	·9637
,, 27	·9655
,, 29	·9623

Japan wax, 1	·9993
,, 2	·9953
Spermaceti, 1	·9162
Carnauba wax	1·0011
Resin	1·0865
Paraffin...	·9171
Fatty acids	1·002

The following are instances of undoubtedly adulterated samples of wax:—

Sample of "*comb-foundation*": 3·7530 grm. gave ·3136 grm. or 8·35 per cent. of cerotic acid, and 1·3385 grm. or 35·67 per cent. of myricine.

Contains much paraffin. Assuming the absence of fat the composition of the sample calculates as follows:—

Cerotic acid ...	5·83	41·50 per cent. wax.
Myricine ...	35·67	
Fatty acid ...	1·66	
Paraffin	56·84	
	100·00	

Another specimen of "foundation": 4·2764 grm. gave ·7929 grm. or 18·54 per cent. cerotic acid, and 3·1373 grm. or 73·36 per cent. myricine.

Contains paraffin. Composition calculated as above.

Cerotic acid ...	11·99	85·35 per cent. wax
Myricine ...	73·36	
Fatty acid ...	4·31	
Paraffin	10·34	
	100·00	

It is noteworthy, that, generally, when paraffin is admixed with wax, the acidity will be found increased, as in the two previous samples: that is to say, adulteration with paraffin is almost invariably accompanied by admixture with fatty acids. I have no doubt that the explanation is found in the fact, that pure paraffin but rarely occurs in retail commerce, all paraffin candles containing a variable proportion of free fatty acid, added to diminish the transparency of the pure hydrocarbon. When I examined some of the test mixtures referred to, I was at first somewhat puzzled by finding added fatty acid, whilst I was informed that none had been admixed. It was soon found, however, that the paraffin candle employed in the preparation of the mixtures contained no less than 12·4 per cent. of fatty acid.

A light yellow sample of wax, "warranted genuine" by the vendor, gave 10·47 per cent. cerotic acid and 69·30 per cent. myricine. From this it follows that the sample consisted of

Wax	79·77
Paraffin	20·23
	100·00

In this case the proportion of cerotic acid to myricine is practically normal.

Another sample, obtained by purchase, gave cerotic acid 18·15, myricine 118·97 per cent. It was free from paraffin.

CALCULATED COMPOSITION.

Wax	70·60 per cent.
Fatty acid	5·42
Fat	21·38
	100·10

In conclusion, I would provisionally warn analysts not to adopt the figures constituting the basis of this paper in judging of the composition of *bleached* wax. It is quite possible —indeed, I have every reason to believe that the changes due to some of the bleaching processes alter the composition of the wax more deeply than is generally supposed. Unfortunately, it is still much more difficult to procure absolutely genuine samples of white wax than of the crude yellow product. I hope very soon to recur to this subject.

I have much pleasure in acknowledging the valuable help given me during the progress of this laborious and extended investigation, by my friend, Mr. B. Halford, B.Sc., and my pupils, Messrs. C. A. Smith and G. Borrett; also to a number of friends, who have most kindly supplied me with most of the pure samples of wax referred to in this paper.

The President, in thanking Mr. Hehner for his paper, said that many of the combs received from America were entirely artificial.

Dr. Muter said that paraffin was practically the only wax adulterant used. As to specific gravity his experience was that a wax containing paraffin had a low specific gravity, and when fatty acids had been added, as well as paraffin, the fatty acids did not much affect the gravity. He had sometimes come wonderfully near in mixtures of wax and paraffin with the gravity alone.

Dr. Dupré said he congratulated the Society on beginning the new year with such an interesting paper. There were two points he wished to refer to. The specific gravity was taken as solid. What precautions did Mr. Hehner take to see that he always got a solid lump, and that his alcohol with an hour's boiling did not affect the standard? Koettstorfer, when he first introduced his method, boiled two quantities of alcohol, one with which he saponified and the other blank, and he came to the conclusion that the boiling did affect the alcohol.

Mr. Kingzett said he felt how wide a field there was for research on the subject. In his own investigation into cocoa butter, he had found two most interesting compounds—one with the highest molecular value known. He should like to have the opportunity of investigating some of those as to which Mr. Hehner had given them such valuable information. What was the result of saponifying bees' wax with aqueous potash?

Mr. Hehner, in reply to the last question, said wax had to be boiled a long time before any result was obtained. If wax were boiled for ten minutes only, the resin is said to be dissolved out, and the wax was not attacked. As to Dr. Muter's remarks, he (Mr. Hehner) would take the specific gravity as a kind of indication, but he would not rely on that as to the composition of a sample. Supposing a normal gravity were obtained, the sample might yet be a considerably adulterated one; or, supposing the gravity was too low, it did not follow that paraffin had been added. He entirely dissented from the statement that paraffin was the only adulterant, but it was no doubt used more than anything else. It might be added to wax without it showing physically, the structure and colour of the mixture differed but little from those of pure wax, while if a little fat were added it made the substance greasy. In fact, he had found one sample adulterated with fat. Referring to Dr. Dupré's remarks, he had only made one blank experiment of boiling alcohol for an hour with alcoholic potash. He had simply taken ordinary methylated spirit to which a considerable quantity of alkali had been added. He distilled it over so that it was absolutely free from acids. He made all his alcoholic potash in that way. He never used ordinary spirit because it coloured too yellow with potash. As to taking the gravities, if the substance were filled in a sufficiently sized tube, the cavity was not wide enough to suck in any air. If large quantities like those he took were worked on, the influence of bubbles was reduced to a minimum.

THE ANALYST.

MARCH, 1883.

SOCIETY OF PUBLIC ANALYSTS.

A General Meeting of this Society was held at Burlington House on Wednesday, the 14th February, the President, Mr. Wigner, in the chair.

Dr. Dupré having opened the ballot papers, reported that Mr. J. G. Ross, Assistant to Dr. Drinkwater, of Edinburgh, was duly elected an Associate of the Society.

The following gentlemen were proposed for election as Members, and will be balloted for at the next meeting, viz.: Dr. C. R. Alder Wright, F.R.S., Mr. Arthur Duncan, Mr. Herbert Crook, and Mr. W. J. Williams.

The following papers were read and discussed:—

"On an Extensive Series of Milk Analyses made during the year 1882," by Dr. P. Vieth, F.C.S.

"On District Standards in Water Analysis," by Dr. A. Dupré, F.R.S., and Otto Hehner, F.C.S.

"On the Analysis of Sulpho-Carbonates," by O. Hehner, F.C.S., and H. S Carpenter, F.C.S.

The next Meeting of the Society will be held at Burlington House on Wednesday, the 14th March, at 8 o'clock.

ON AN EXTENSIVE SERIES OF MILK ANALYSES MADE DURING THE YEAR 1882.

By Dr. P. Vieth, F.C.S.

Read before the Society of Public Analysts on the 14th February, 1883.

The communications I am going to bring before you relate to a great number of milk analyses, executed during the last year in connection with the controlling system carried on by the Aylesbury Dairy Company. This system is a very extensive one, and does not begin only after the milk has been received on the company's premises, but at the very source of the milk—on the farms.

It would be going too far to dwell upon all the details at any length, and, therefore, I will sketch only the most essential points. After the milk has arrived on the company's premises the contents of each churn are thoroughly mixed and tested with thermometer and lactometer, temperature and specific gravity being recorded. In case a divergence to any considerable extent from the figures usually found should be noticed, the milk is not sent out, at least, not before its genuineness is proved. At least one sample of milk from each farmer is analysed daily or every other day, care being taken to get alternately samples of morning and evening milk. Before the milk leaves the yard other samples are drawn from the delivery churns, tested with the lactometer and kept until after all the men have returned from their rounds, so that these samples may be compared with samples taken in the streets by the company's own inspectors from the men in charge of the rounds, and for the purpose to control the latter.

The samples thus taken by the inspectors are analysed, and these samples in connection with those taken of the milk on its arrival form the greatest part of all the samples analysed. The total number of all the analyses made during the year 1882 is 12,480. Of this number 12,349 are milk samples. Among the latter there are 9,190 samples taken on arrival of the milk in the dairy and before it was sent out, and 2,948 samples taken by the company's own inspectors in the streets during delivery of the milk to the customers.

As some of the rounds go rather far and the delivery of the milk occupies several hours, some alteration in the distribution of the fat might be expected, and in some cases could be proved. But there was never a difference of any importance in the average composition of the two kinds of milk samples. except in a case I brought before you at the last November meeting.

Regarding the analytical method applied, I refer to the paper I read before this Society in the month of March last year, and repeat only, that the total solids are ascertained by evaporating 5 c.c. of milk in a shallow platinum dish, which is kept on a steam-bath for three hours and in an air-bath at a temperature of from 95° to 100° C for the same length of time, whilst the fat is determined by means of Marchand's lactobutyrometer, an instrument which gives, when properly worked, very good and reliable results in a short time. After having used the said instrument very extensively for more than two years, I think it exceedingly suitable for the milk control. Chemists, who have made and published experiments with the lactobutyrometer differ in their opinions as regards working the instrument in one point, viz., whether it is better to prevent the precipitation of the casein by adding a few drops of a potassium hydrate solution, or whether it is to be preferred not to do so, perhaps even to precipitate the casein by adding some acetic acid. My experience on the point is this, that during the time the cows are housed the fat rises better if some potassium hydrate be used, whilst during the warmer part of the year better results are obtained, and in a shorter time, without the addition of potash. I have reason to believe that this different behaviour of the milk has something to do with the swollen state in which the casein is believed to be present in milk. By practical experiences it appears that the degree of the swollen state of the casein is influenced to a certain extent by the conditions under which the cows are kept and how they are fed.

I shall give you now the monthly averages for the composition of samples taken of the milk when received :—

TABLE I.

1882.	Specific Gravity	Total Solids.	Fat.	Solids not fat.
January	1·0317	12·89	3·36	9·53
February	1·0320	12·76	3·26	9·50
March	1·0320	12·73	3·16	9·57
April	1·0320	12·96	3·10	9·56
May	1·0321	12·95	3·40	9·55
June	1·0317	12·96	3·55	9·41
July	1·0316	12·99	3·57	9·42
August	1·0315	13·04	3·60	9·44
September	1·0319	13·12	3·60	9·52
October	1·0321	13·36	3·75	9·61
November	1·0321	13·40	3·82	9·58
December	1·0319	13·14	3·75	9·39
Yearly Average	**1·0319**	**13·08**	**3·52**	**9·51**

By this table it appears that the milk contained the lowest amount of total solids and of fat in the month of March, the highest in the month of November. The extreme figures for total solids are 12·73 and 13·40, for fat 3·16 and 3·82 per cent. The solids not fat fluctuate in very narrow limits only, the lowest figure being 9·89 and the highest 9·61 per cent. The specific gravity is also very constant. The yearly average of the total solids is 0·23 per cent. higher than that of the year 1881.

Interesting as the figures in Table I., showing the average composition of the milk from all the contractors, may be, they do not allow us to draw any conclusion regarding the composition of the milk supplied by the individual farmers, and in this respect the following Tables II. and III. may prove to be of greater importance. They show for each month the average composition of the milk delivered from those farmers being first and last on the list.

	TABLE II.				TABLE III.			
	Specific Gravity.	Total Solids.	Fat.	Solids not Fat.	Specific Gravity.	Total Solids.	Fat.	Solids not Fat
January	1·0330	14·41	4·00	10·41	1·0314	12·14	2·95	9·19
February	1·0330	14·50	4·07	10·43	1·0311	12·05	2·98	9·07
March	1·0328	14·62	4·07	10·55	1·0319	12·03	2·91	9·12
April	1·0329	15·19	4·78	10·11	1·0315	12·38	3·16	9·22
May	1·0325	14·86	4·59	10·27	1·0322	12·46	3·08	9·38
June	1·0327	14·33	4·33	10·00	1·0311	12·46	3·41	9·05
July	1·0316	13·47	3·80	9·67	1·0316	12·58	3·34	9·24
August	1·0322	13·36	3·69	9·67	1·0312	12·62	3·39	9·23
September	1·0320	13·60	3·87	9·73	1·0315	12·76	3·44	9·32
October	1·0322	13·86	3·97	9·89	1·0321	12·90	3·44	9·46
November	1·0320	14·14	4·16	9·98	1·0314	12·70	3·51	9·19
December	1·0311	14·13	4·38	9·75	1·0320	12·29	3·32	8·97

The total solids fell in proportionately very few cases only below 12 per cent.; fat was found to amount very seldom less than 3 per cent.; the solids not fat kept generally above 9, but in some instances came down to 8·8 per cent.

I must insist upon my opinion that an amount of solids not fat below 9 per cent. does not always mean that the milk has been watered, provided total solids and fat to be exactly ascertained.

In my laboratory, the specific gravity is determined of about 250 milk samples daily—of course, by means of the lactometer. In far the most cases the specific gravity is found to be between 1·030 and 1·033, sometimes it rose to 1·034, but scarcely fell below 1·030, and, in fact, we look with suspicion at a milk with a lower specific gravity.

Summing up the experiences collected by another year's work in a very special direction, I come to about the same conclusions, which I, for the first time, put before you one year ago. I think the standard figures for fat and solids not fat ought to be altered, the former being raised so much as 0·25 per cent., the latter being reduced to the same extent, so that the limits for genuine milk would stand as follows:—Total solids, 11·50; fat, 2·75; and solids not fat, 8·75 per cent. I am fully aware of the disadvantages induced by the alteration of a standard after it has been once fixed, but these disadvantages will have to be faced as soon as the advantages are found to be greater. I do not doubt that the Society's standard was right, and is right, if the milk analysis is executed according to the method fixed by the Society. But since some analysts do not dry the solids on the water-bath only, but additionally in the air-bath, and extract the fat—not by boiling the solids with from three to six successive quantities of ether, but by exhausting them in Soxhlet's apparatus—the conditions are somewhat changed. You will remember that Mr. Hehner, in his paper, read before our Society in the month of March, last year, pointed out, that extracting the milk solids in Soxhlet's apparatus yields about 0 2 per cent. more fat than boiling out with ether. I have reason to believe that the difference will be still larger, if not Soxhlet's apparatus only, but Soxhlet's method is applied, which consists in drying up the milk with plaster of Paris and exhausting the dry powder.

Dr. Dupré said the paper did not show that the standard of solids not fat required to be lowered below 9 as there was only one case which was below that figure. He supposed each figure referred to the milk from a number of cows, and asked if Dr. Vieth could add to the tables the maximum and minimum for single cows. He himself never got into difficulty with the standard of 9 where there was a number of cows.

Mr. Piesse said he thought they ought to feel very gratified that the averages in the tables bore out the standards of the Society, and no doubt they were extremely valuable, but he did not see how they were to apply them in the teeth of the results obtained, and acted upon by the Somerset House Chemists, who apparently derived those results from analyses made upon milk drawn from a single cow.

Mr. Hehner said he did not think that in fixing standards they had anything to do with the Somerset House Chemists, who should be left out of the question altogether in a scientific discussion. All they had to do was to arrive at the truth. He found that Dr. Vieth's results bore out the formula which he proposed some time ago, and he gave one or two illustrations to show this.

Mr. Piesse said he had made a great number of milk analyses since Mr. Hehner's paper was published and generally found them agree.

The President said he differed from Dr. Vieth in respect of the necessity for altering the standards, and especially looking at Tables II. and III., because if Table II., acknowledged to be milk picked from the best dairies, was correct, the standard adopted by the Society was on the average about 15 per cent. too low, while if the worst dairies were taken, Table III., the standard was about 3½ to 4 per cent. too low; thus one farmer might water to 3½ per cent. and the other to 15 per cent. without transgressing the limit of the Society. As they all knew a deficiency of ·2 or ·3 per cent. in solids not fat would not be noticed further than to say that the milk was poor, and he thought the lowering of the standard for that would be a wrong thing to do. As to Somerset House he personally had nothing to say, and quite agreed with Mr. Hehner that that question should be left out of a scientific discussion. He thought Dr. Vieth's figures strongly proved that the Society erred on the safe side when the standard of solids not fat was fixed. As to the fat, Dr. Vieth would wish to see that standard slightly raised, and no doubt the figures bore the reasoning out considerably. With a large company, distribution meant a regular organised system when the churns were not out probably more than three or four hours and the cream did not separate, but in the case of men who only did one or two churns a day and these were perhaps out for six or eight hours, then he thought the separation of the cream might take place, but he hardly saw his way at the moment to suggest an increase in the fat standard.

Dr. Dupré asked if any Public Analyst took 2·5 for fat and ever got convictions.

The President and Mr. Hehner both replied that they had done so.

Mr. Dyer said that one thing ought to be kept more in mind than it was, and that was that when the solids not fat in natural milk was low, the fat was unusually high, not in proportion but in a much greater proportion. Some time ago he brought before the Society a large number of milk analyses undoubtedly genuine and taken all through the summer season, and in those the solids not fat rarely reached 9, and sometimes was as low as 8·5, but they were rich in cream, the percentage running up to 4·5 and 5·0.

Dr. Vieth, in reply to Dr. Dupré, said he could not give the maximum and minimum solids not fat of single cow's milk, but only of the mixed milk of several cows. With regard to rich and poor milk, it was certainly to be taken into consideration that the rich milks in Table II. came from farms where Jersey cows only, or a great number of them, were kept; while the milks in Table III. came from farms where other cows were kept. With regard to the solids, as he had said in his paper, it depended very much whether they were boiled with ether or exhausted in Soxhlet's apparatus. Where the fat was properly extracted he was sure that in many cases the solids not fat would be below 9 per cent.

ON THE ANALYSIS OF SULPHO-CARBONATES.

By Otto Hehner and H. S. Carpenter, F.C.S.

Read before the Society of Public Analysts on 14th February, 1883.

Solutions of carbon bisulphide in potassium sulphide—so-called sulpho-carbonate, K_2CS_3—occur at present in commerce, and are valued in proportion to the percentage of carbon bisulphide contained in them. Several chemists have lately published their experience in regard to the analysis of those solutions, but the processes they adopted appear to us defective on the score of either accuracy or convenience. The principle of all the methods is identical; solution of some metallic salt is added, and the precipitated metallic sulpho-carbonate is decomposed by heating into metallic sulphide and carbon disulphide. Thus, Guyot Dennecy (*J. Pharm.* [5] 6, 336, abstract in *Chem. Soc. Journ.*, Feb. 1883) adds the sulpho-carbonate drop by drop to a hot solution of 100 grms. of zinc chloride, contained in a 2 litre flask, distils and measures the carbon disulphide. E. L. de Bouquet (*Mon. Scient.*, 1882, 994, abstract in *Berl. Ber.* 1882, 2938) decomposes with copper sulphate, distils, passing the vapour through alcoholic potash, olive oil and bromine water, estimating ultimately the sulphur as $BaSO_4$.

We find that the process may be very much simplified as follows:—To three to five grms. of the solution, strong cold lead acetate (or other metallic solution) is added, until the liquor in which the precipitate is suspended is colourless, the whole being contained in a small tubulated retort, capable of holding about 6 to 8 ounces. The retort is connected with two nitrogen bulb tubes, filled with *strong* alcoholic potash solution, and kept cool by immersion in water. The contents of the retort are heated to boiling and kept so for about five minutes. The whole of the carbon bisulphide is absorbed by the alcoholic potash, the second bulb tube rarely containing more than traces. The clear contents of the tubes are then washed into a beaker, rendered slightly acid with acetic acid, and the xanthate which has resulted from the combination of the bisulphide with the alcohol, is titrated with copper sulphate solution, containing per litre 12·47 grms. of crystallised sulphate, 1 c.c. corresponding to ·0076 grms. CS_2 (Macagno's solution). The yellow copper xanthate readily conglomerates on agitation, leaving the liquor practically clear. When, on addition of the copper solution, a further precipitate can no longer be observed, a drop of the liquor is taken out with a glass rod, placed on a double piece of filter paper, and the spot on the lower paper is touched with a little ferro-cyanide solution. On the appearance of the faintest pink tint, the amount of copper solution used is read off. The total volume of liquor is then measured, and for every 100 c.c., 1 c.c. of standard solution is subtracted, that amount being necessary to produce, when diluted with 100 c.c. of distilled water, a pink tint with ferro-cyanide on filter paper. The number of c c. multiplied with ·0076 gives the amount of carbon bisulphide obtained. The whole process takes barely 10 minutes.

The following figures will show that the method is sufficiently accurate for practical purposes :—

1 0435 grms. of CS_2 (weighed in a thin glass bulb) were dissolved in alcoholic potash Copper solution used, 137·2 c.c., minus 2·5 = 134·7 c.c. corresponding to 1·0237 grms. or 98 1 per cent. CS_2.

·9660 grms. CS_2 used 131·3 c.c.—2·5 = 128·8 c.c. = ·9789 grms. or 101·8 per cent. CS_2.

·7141 grms. used 94 1 c.c.—2 c.c. = 92·1 corresponding to ·6999 grms. or 98·0 per cent.

·7990 grms. took 108 c.c. — 2·5 = 105 5 c.c., equal to ·8018 grms. or 100 3 per cent.

Average 99·4 per cent. CS_2.

We also made a number of experiments to convert a weighed quantity of CS_2 into sulpho-carbonate by treatment with potassium sulphide, but were not able to dissolve the whole of the quantity taken. Sulphur separated, and obstinately retained some of the carbon disulphide.

33 78 grms. of a commercial sample of sulpho-carbonate were diluted to 500 c.c.

50 c.c., heated as described, yielded an amount of xanthate which used 55·5 c.c. copper solution = ·4218 grms. or 12·49 per cent CS_2.

50 c.c., ditto, used 57·0 c.c. = ·4332 grms., or 12·82 per cent.

The following results show the importance of adding the metallic solution *cold* to that of the xanthate :—

50 c c. of the above fluid were heated nearly to boiling, and after cooling, mixed with lead acetate. Copper solution used 54 5 c.c. = ·4142 grms. or 12·26 per cent. CS_2.

50 c.c. boiled for 5 minutes previous to the addition of the lead. Copper solution used, 42 5 c.c. = ·3230 grms., or 9·56 per cent. CS_2.

50 c.c. boiled for 8 minutes. Copper solution used, 33·0 c.c. = ·2508 grms., or 7·42 per cent. CS_2.

50 c.c. boiled for 20 minutes, used 16·8 c.c. copper solution = ·1277 grms. or 3·78 per cent. CS_2.

The sulpho-carbonate, by boiling, is well known to be converted into carbonate, $K_2CS_3 + 3H_2O = K_2CO_3 + 3H_2S$.

We add a few analyses of commercial samples :—

	Sp. Gr. 1·413	Sp. Gr. 1·422	Sp. Gr. 1·429
CS_2	11·78 by weight.	10·63	10·34
K_2O	24·68 per cent.	24·39	24·71
Na_2O	·61	1·29	·74

TESTING OF JALAP.

BY H. HAGER.

Two sorts of true jalap are distinguished in commerce, viz., the light and the heavy. Since there is no external criterion to distinguish them, the pharmacist must have recourse to other means of distinguishing them, which should, however, be such as will not injure the tubers. The process recognized by the Pharmacopœia, namely, the assay of the resin, is, in the first place, too circumstantial, and, secondly, it can only extend to *one* tuber at a time. Yet it is important to examine *all* tubers contained in a lot, with a view of detecting fraudulent admixtures. Among the latter may be expected partially exhausted tubers, that is, tubers into which fine incisions had been made, after which they were laid into absolute alcohol for eight or ten days. This treatment removes most of the resin, leaving scarcely three per cent., and, after drying, the tubers present the same appearance as before extraction.

In order to determine the specific gravity of jalap, I took five tubers of similar appearance and threw them into water, when all but one sank under. Resin and sugar, which are present in the tubers, render them heavier than water. The spec. grav. of the resin is 1·15 to 1·16, and that of sugar 1·5 to 1·6. The tubers which sunk in water were found to have a spec. grav. of 1·150 to 1·180. Hence the minimum specific gravity may be put at 1·140, and the pharmacist should reject any jalap having a lower gravity.

The determination is best made by means of a solution of common salt having the spec. grav. 1·140 to 1·142; and the requirement is that at least ninety tubers out of every hundred should sink in this liquid.

To prepare such a solution, two hundred grams of dry commercial table salt are dissolved in 1,055 cubic centimeters (or grams) of water. About fifty tubers are then immersed in this liquid, while being stirred, at a temperature of 15° to 17° C. Should some of the tubers be retained on the surface by numerous adhering air-bubbles, it is only necessary to rub them with the finger, when they will readily become wet. After examination, the tubers are put into a sieve, washed off with water, and dried with a linen cloth.

Although it is stated above that 1·140 to 1·142 may be set down as the lowest permissible specific gravity, it will probably be found, on further examination, that the limit may be raised to 1·150.—Abstr. from *Pharm. Centralh.*, 27.

EXAMINATION OF BEERS FROM BEERHOUSES AND BREWERS.

By J. Carter Bell.

Read before the Society of Public Analysts, on 15th December, 1882.

I have lately been making an investigation upon the beers sold in Salford by beerhouse keepers and also by brewers, and I may state that in no case have I found any serious adulteration, the only matter which I consider foreign is the large amount of common salt found in some of the beers; this was not as a rule put in by the beerseller, but by the brewer himself.

I have followed out the same plan here that I am accustomed to do in my milk examinations; if the beer from the beershop was suspicious, a sample was procured from the brewer, and in nearly all cases it was found identical with that which had been bought from the beershop.

In the examination of the beers for noxious materials I have used the following process kindly given to me by Dr. Dupre.

Two pints of the beer were evaporated to a thin syrup, to this was added one pint of pure rectified spirit, the spirit was added very gradually, stirring at the same time; when the whole of the spirit has been added, let the syrup mixture stand for about fifteen minutes, pour off the spirit and distil; the residue from the spirit is dissolved in water rendered alkaline with soda hydrate, and several times shaken up with ether. The ether solution contains the bitter principle of the hops, any alkaloids that might be present, resinous matter and fat. The alkaline solution is now acidified with acetic acid, and again shaken up with ether, the ether evaporated, the residue taken up with water and added to about a pint of water, into this water some small fish, such as minnows, are placed: if they live and are healthy, one may be certain that no dangerous alkaloids are present; if they should turn over upon their backs and die, it is evident that something is present which is foreign to good beer.

The following beers were bought for sixpenny beers. It will be seen that there is great variation in the quality, but in no case is there a beer with less original gravity than 1040, From this it would not be difficult to make a standard for beer.

The following samples were bought from beershops :—

Specific Gravity.	Proof Spirit	Specific Gravity of Residue made up to 100 c.c.	Extract per cent.	Ash per cent.	Salt, grains in gallon.	Acetic Acid per cent.	Original Gravity.
1009	11·5	1018	4·60	·25	21·5	·30	1058·6
1010	11·5	1019	1·75	·25	51·1	·30	1059·5
1010	12·6	1016	5·52	·37	74·9	·29	1060·5
1007	11·5	1017	3·7	·30	57·1	·37	1057·8
1007	12·6	1016	5·54	·20	48·1	·26	1060 3
1008	11·5	1015	4·75	·20	25·7	·13	1051·8
1008	9·9	1018	4·0	·12	5·9	·13	1051·9
1007	11·5	1015	1·52	·42	15·5	·27	1055·3
1012	10·4	1018	5·89	·25	17·6	·14	1053
1027	11·5	1018	5·76	·34	31·5	·48	1059·6
1010	11·5	1019·5	4·86	·32	14·6	·42	1060·8
1010	9·8	1019·5	4·76	·16	14·7	·36	1054
1008	11·5	1016	3·81	·26	14·7	·36	1056·9
1010·5	10·9	1021	4·89	·36	16·1	·44	1059·4
1012·5	10·9	1022	5·16	·37	14·0	·16	1059·6
1011·5	8·8	1019	4·61	·36	72·1	·19	1048·3
1006	11·5	1017	3 96	·42	67·9	·12	1056·2
1009	11·5	1018	4·39	·35	36·4	·48	1059·1
1012	11·5	1019	4·96	·27	13·3	·42	1060·3
1010	11·5	1020	5 26	·36	21·7	·13	1059·5
1009 5	11·5	1018·5	4 79	·39	78·4	·14	1058
1015·5	11 5	1015	3 66	·38	75 0	·12	1051·5
1007·5	14·2	1017	2·82	·28	53·2	·12	1066·3
1012	10·2	1019	4 38	·37	81·9	·16	1053·3
1010	10·2	1018	4·53	·31	51·1	·14	1052·2
1010	13·7	1019·5	4 90	·33	65·1	·12	1068·5
1023	7 1	1021·5	4·97	·28	9·8	·14	1052
1013	11·5	1023	5·88	·45	115·5	·14	1062·5
1014	10 9	1022	5·62	·22	7·5	·12	1061·1
1009	11 5	1019·5	5·20	·45	86·8	·12	1059
1007·5	9·3	1014·5	3 52	·24	12 6	·14	1045·5
1012·5	10·9	1020	5·47	·13	42·7	·12	1057·3
1019	8·8	1026	6·46	·33	11·2	·21	1055·5

Comparison of samples of beer obtained from brewers and dealers respectively :—

	Specific Gravity.	Proof Spirit.	Specific Gravity of Residue made up to 100 c.c.	Extract per cent.	Ash per cent.	Salt, grains in gallon.	Acetic Acid per cent.	Original Gravity.
Brewer	1013	10·1	1021	5·20	·23	56·7	·24	1055·8
Dealer	1010	10 2	1019	4·85	·22	55·3	·18	1053·4
Brewer	1014	11·5	1017	5·60	·21	48·3	·24	1057·2
Dealer	1008	10·4	1016	4·85	·32	43·4	·29	1052·3
Brewer	1015	10·1	1023	6·91	·26	37·8	·20	1057·5
Dealer	1012	10·7	1018	5·93	·33	39·2	·20	1065·7
Brewer	1021·5	7·5	1027	7·20	·30	62·3	·18	1053·7
Dealer	1011	13·7	1016	4·18	·33	129·5	·27	1064·1
Brewer	1015·5	10·1	1024	6·10	·26	43·4	·27	1058·9
Dealer	1008	10 2	1018	4·59	·34	69·3	·25	1052·8
Brewer	1009	10·1	1018	4·46	·26	44·8	·18	1052·4
Dealer	1010	11·5	1018	4·94	·34	42·6	·27	1058·4
Brewer	1010	10·1	1018	4·50	·20	7·0	·12	1052·4
Dealer	1009	10·2	1016	4·34	·24	20·3	·25	1050·9
Brewer	1010	10·1	1018	4·16	·16	15·4	·18	1052·4
Dealer	1011	9·3	1018	4·72	·27	23·8	·20	1049·5
Brewer	1016	12·6	1024	6·36	·36	100·1	·24	1067·7
Dealer	1010	13·1	1017	4·80	·40	103·6	·37	1063·7
Brewer	1013	11·5	1022	4·49	·32	30·8	·42	1063·3
Dealer	1007	14·2	1018	5·96	·20	29·0	·17	1067·6
Brewer	1015·5	9·8	1023·5	5·81	·23	46·2	·12	1058·3
Dealer	1015	9·3	1021·5	2·97	·31	11·9	·11	1052·5
Brewer	1008·5	11·5	1018	3·92	·38	69·3	·31	1058·6
Dealer	1009	11·5	1018·5	4·50	·38	80·5	·48	1040·1
Brewer	1011·5	10·9	1016	5·10	·32	26·2	·36	1054·9
Dealer	1009	11·5	1018·5	4·56	·38	80·5	·48	1060·1
Brewer	1011·5	10·9	1016	5·10	·32	26·2	·36	1054·9
Dealer	1011·5	9·3	1019	4·85	·33	37·1	·16	1054·4

It appears from the above tabular statement that beer is generally sold by the dealers in nearly the same state as they receive it from the brewers. The discrepancies in the analyses of brewers and dealers samples may be accounted for by the sample being obtained from the brewer many days after the dealer's sample was obtained.

ON THE WORK DONE BY THE PARIS MUNICIPAL LABORATORY.

By W. Douglas Hogg, M.D., of Paris.

Read before the Society of Public Analysts on the 15*th December*, 1882.

Some very important steps have lately been taken in France towards the suppression of adulteration. Laboratories have been opened and inspectors appointed by several municipal authorities, who, according to the French laws, have power to punish offences committed against the statutes concerning the adulteration of food.

The municipal council of the town of Paris, on the 27th October, 1880, ordered the establishment of a laboratory at the Prefecture of Police, which was consequently opened to the public on the 1st March, 1881. The example has this year been followed by Lyons, Marseilles, Bordeaux, Rouen, Ronbaix, Nantes, Lille, Montpellièr, Melun, &c.

The officials employed consist of a director, inspectors, and chemists holding scientific titles, and subjected to an examination on entering or being appointed, several occupying the grade of Pharmacien. We shall see by the following the list of the officers and employés.

The inspector's duty is to take samples from those houses trading in provisions, and in the markets of the town, and they are assimilated for those functions with the *Commissaires de Police*. Their mode of operation is very simple. They present themselves in pairs at the place pointed out to them by a dissatisfied purchaser of a sample lately bought there, which on analysis at the laboratory had been found to be adulterated. They ask the tradesman to allow them to examine the products exposed for sale, and make a preliminary examination, either with a microscope or with the reagents enclosed in two small boxes which they carry with them. In case the products appear adulterated, the inspectors take two samples, sealed, numbered, and certified, both by them and the tradesman: one of these samples is analysed at the laboratory and the other is put aside in case of dispute. They draw up a *proces verbal* of seizure.

The daily employment of the inspectors is sent each day to the chief of the laboratory in the form of a report. This report contains the smallest details upon the healthiness of the establishment visited, the seizures made, and the destruction of unsound products.

It will be seen that the public are most important auxiliaries to the laboratory, as they report also upon articles they believe adulterated.

From the 1st March, 1881, the date of the opening of the municipal laboratory to the public, the latter have been invited, by means of notification, to cause to be analysed the drinks, provisions, and all articles of food used by them and of interest to health. At that time there was only one office at the Prefecture of Police. The samples were, and are still received by a comptroller, who inserts in a book kept for the purpose the nature of the sample, the date it was bought, the number of the depôt, the name and address of the depositor, and, lastly, the name, profession, and address, of the seller; then the comptroller extracts from a register a receipt which he remits to the depositor, indicating the date when the result of the analysis may be known.

The analyses are divided into two categories—one called qualitative (gratis) and the other quantitative (which are paid for). The first gives simply a report on the product deposited, without stating its composition, and confined to, or explained in, the following words:—Good, passable, bad (not injurious), bad (injurious).

The quantitative analyses, the fees for which vary, according to the nature of the samples, from 5 to 30 francs, give the exact composition of the product. Besides the receipt in this case, the comptroller detaches a note to pay into the municipal treasury.

It was very soon found that one office was insufficient, and to avoid a loss of time to the public, *M. le Prefet de Police* authorized the *Commissaires de Police* of the district to accept samples for qualitative analyses only. The samples sent to the *bureau* of police are placed in a chest *ad hoc*, and brought each day to the laboratory by the prison van, together with the samples taken by the chemical inspectors during their visits to the tradesmen.

Every product which enters the laboratory, whatever may be its nature, is analysed *quantitatively*, and it is upon the figures obtained that the chief of the laboratory bases his opinion.

Each analysis is registered in a book for the purpose, which remains at the laboratory and forms part of an important collection.

Besides the samples received from the public and from the inspectors, the laboratory has to treat daily a great number of samples from the Prefecture of the Police, the *octroi* of Paris, the hospitals, the prisons, &c., &c.

WORK OF THE LABORATORY.—The routine of the laboratory is confined to the analyses, chemical and physical, of the articles which are sent. It does not value, but simply gives an appreciation, which is transmitted to the *Prefet de Police.* The reports are, further, handed down to the public prosecutor, who institutes proceedings against the offenders.

The attention of the laboratory has, from the beginning, been called to the determination of the normal composition of articles of food. With this object, most careful analyses have been made of numerous samples of wine, vinegar, beer, cider, spirits, syrups, water, milk, butter, oil, flour, bread, &c. The results obtained on wine and milk are noted further.

Photographic apparatus has been provided, affording the analysts the advantage of putting before the eyes of the jury and judges a palpable proof of the detected adulteration —for instance, in pepper, flour, and confections—or showing them the presence of trichini, cysticerci, &c.

The following table illustrates the number and quality of samples examined monthly during the year 1881 :—

Month.	Number of Samples.	PERCENTAGE OF ADULTERATION.		
		Milk.	Wine.	Total, calculated on samples of all classes.
March	504	51·40	62·30	54 50
April	583	56·40	74·10	49·30
May	672	79·00	79·60	63·40
June	760	66·60	69·80	61·50
July	721	68·20	50·70	55·40
August	619	59·70	55·80	52·80
September	606	30·90	60·20	51·40
October	691	31·00	42·20	38·40
November	634	17·50	50 80	39·70
December	727	46·00	45·20	37·90
	6517	50·67	59·17	50·43

These 6517 samples can be also classified as follows :—

Good	1565
Passable	1523
Bad (not injurious)	2608
Bad (injurious)	562
	6258

The 259 remaining samples were still under examination at the end of 1881.

Examinations of Wine.—The average of 2000 samples of wine have been found to contain—

Alcohol	12°
Extract, dried at 212°	20 grammes.

The allowed percentage for wines commercially sold has been lowered to—

Alcohol	10°
Dry extract	20 grammes.

Wine has been found to be commonly adulterated by addition of water to the extent of 20, 30, and even 50 per cent.

Examination of Milk.—The same process was followed concerning milk. After analysing 900 samples of divers origin, the normal composition was found to be—

Density	1033
Cremometer	10°
Water	87 grammes per cent.
Residue at 95° C... ...	13 ,, ,,

The residue is composed of—

Ash	0·60 gr. per cent.
Butter	4·00 ,, ,,
Lactine	5·27 ,, ,,
Casein and albumin... ...	3·60 ,, ,,

To be considered adulterated, milk must contain over 10 per cent. of water. This allowance may be regarded as very liberal, considering the great importance of milk as a food for infants. A small quantity of bicarbonate of soda is also tolerated, especially in the summer season.

The budget of the laboratory amounts to £5,200, thus divided :—

	£
1 Director of the Laboratory...	240
1 Sub-director	180
1 Analyst (1st class)...	96
3 ditto (2nd class)	216
16 Inspectors (1st class)	1,680
16 ditto (2nd class)	1,164
3 Employés and Porters	200
General Expenses	192
Total ...	£3,968

The rest of the sum is applied to the purchase of instruments, books, &c.

The figures shown in the table should not be considered as strictly representing the state of things in France. It must be said that, up to very lately, the Paris laboratory was in reality the only one existing in the whole country. Consequently, the observations we had occasion to make at the last International Medical Congress, in order to explain the enormous percentage observed during the first five months, stand true for the whole year. We remarked that it would be unfair to say that over fifty articles of food out of a hundred are adulterated in France : for this reason, that the samples on which those percentages had been taken had, before being forwarded from all parts of the country to the laboratory, excited some suspicion as to their purity, and had been picked, so to say, from among many genuine articles. It is very difficult, upon these grounds, to form a correct opinion. The truth can only be got at by the examination of articles purchased indiscriminately wherever they are on sale. When this year's report is published, it will, in a certain measure, prove the correctness of our suggestions.

Last year's report has just been issued, forming a most valuable work, due to the pen of M. Charles Girard, Director of the Paris Laboratory, and a Member of this Society.

I can only give a rapid sketch of this interesting compilation, taking among the numerous articles examined some of the most important adulterations.

It will be remarked that drugs are not comprised among the substances analysed. In France, *pharmaciens* are inspected by members of the School of Pharmacy, who alone have the right of entering in their *officine*.

Concerning milk, the report reads as follows:—

"The principal adulterations consist in the addition of water, and in the subtraction of cream: this fraud, though inoffensive for adults, must be considered as a most serious one when milk is employed for feeding young children. From the 1st of March, 1881, to the end of the year, 1,008 samples have been analysed—838 were brought in by the inspectors and 170 by the public. The percentage of adulteration in the first case was 15·46 per cent., and in the second case 16·79 per cent."

Divers substances have been detected in the milk—viz.: oatmeal, white of egg, dextrine, sugar, and even brain matter, oils, and fats. The majority of the samples adulterated were made up with extracts of milk and water, or ordinary milk deprived of its cream, to which water had been added in the proportion of 10 to 40 per cent.

The adulteration of wine is more complicated: mixed with water it loses its colour, and, consequently, some colouring substance must be added; likewise alcohols of inferior quality. M. Charles Girard values the loss annually sustained by the Treasury at more than £140,000.

Wines manufactured with dried raisins, artificial ethers, cream of tartar, tannin, glycerine, &c., have often come under the Parisian analysts' notice. Also wine containing oxide of lead, alum, salt, salicylic acid: sometimes arsenic in liquids coloured with fuchsine.

The number of samples examined were 3,361, which can be classified as follows:—

Unhealthy wines (acid, bitter, musty)	6·51	per 100.
Mixture of different wines	9·55	,,
Containing less than one or two grammes of plaster ...	24·45	,,
,, more ,, ,, ,, ...	75·55	,,
Mixed with water	41·12	,,
Sugar and dried raisins	3·30	,,
Artificially coloured	15·65	,,
Salicylated	4·73	,,
Salted	0·18	,,
Containing alum	0·029	,,

The substances most frequently employed in adulterating beer are: picric acid, gall, aloes, colocynth, cocculus indicus, cubeb mixed already for use, with nux vomica and carbonate of soda, strychnine, box leaves, juniper, &c.

Sixteen samples of spirits, out of 36, were found adulterated—7 with foreign alcohols, 4 coloured artificially with burnt sugar, 5 with artificial essences. Of the 33 samples of *liqueurs*, 9 were coloured—5 containing fuchsine, 16 glucose. Sulphuric acid, copper, and dextrine were detected in vinegar; foreign fats and oils, and powdered date kernels, in chocolate; foreign vegetable substances, French chalk, residues of fecula manufactory, and powdered olive kernels, in pepper; colouring substances derived from lead, copper and arsenic, in syrups and jams; &c., &c.

Butter only gave 11 pure samples out of 62 examined, meal 13 out of 31, bread 9 out of 13. Preserved vegetables were often found to contain copper—11 times out of 35.

I regret not to be able to mention many other interesting points recorded by the eminent director; but I fear I have already trespassed on the space kindly granted me in these columns. Before ending, I will add that the endeavours of the laboratory have brought on a notable decrease in the number of adulterated articles sold in Paris and France generally. In a certain measure, the hopes expressed of late years, when the establishment of laboratories was being advocated, have been realized; and I am happy to have been able to contribute, in the limited measure of my means, to the founding of an institution which will produce, in time, most serviceable results.

NOTE ON REINSCH'S TEST.

By J. Macallan, F.I.C., Chem. Demonstrator Royal Coll. Surgeons, Dublin.

Read before the Society of Public Analysts on the 14th February, 1883.

In testing for arsenic by Reinsch's method there is a serious source of error which seems to have been overlooked; at least, I can find no reference to it in any of the standard works on the subject. I allude to the deposition of free sulphur, together with cupric sulphide, on the copper, and its sublimation when heated. In examining decomposing organic substances sulphur is frequently deposited owing to the decomposition of free sulphuretted hydrogen, so much so, sometimes, as to take fire and burn with a blue flame when a lighted taper is applied to the copper. When heated in a tube, the sulphur forms a sublimate having a general appearance and behaviour similar to that of arsenious oxide, in small quantity being white and resubliming unaltered. It is mentioned in some works that sulphur cautiously sublimed condenses in rhombic octahedrons, but I have not found it deposit in that form. Under the microscope it is seen to consist of globules. When, however, these are so small as to render their outlines indistinct, they resemble closely the crystals of arsenious oxide in transparency, lustre, and aggregation. When doubt exists, the safest course might be to procure as much of the sublimate as possible, boil down a second time with dilute acid and copper, and examine any sublimate obtained, microscopically and with the usual confirmatory tests.

PEPPER DUST.

We take the following from our trade contemporaries, "*The Grocer*" and "*Grocers' Gazette*:"—

At the weekly spice sales in Mincing Lane, lately, a well-known firm of brokers proceeded to the sale of 608 bags (30 tons) black pepper-dust—which had been postponed from a previous day on account of an objection raised in the room as to the impurity of the pepper—when Mr. Daniel Harvest rose and reminded the selling-broker that at the previous sale he (the broker) had made two statements: one expressing his belief that the pepper was merchantable, and the other that a sample should be sent to Somerset House for analysis. As to the first, it was answered by the analyst's report at the head of the catalogue*; and with respect to the second statement, he would read a letter from the Principal of the Laboratory, Somerset House. Mr. Harvest accordingly read the letter, which stated that the brokers had not sent samples to that department, but that the samples submitted by the speaker showed the article contained nearly 50 per cent. of mineral matter, that is, stones, lime, and dirt; that the vegetable matter, namely, pepper leaves, husks, &c., "smells mouldy and unsound." The letter further stated the article was not fit for food, and should be brought under the notice of the officer of health. Mr. Harvest remarked that this letter fully vindicated the course he had adopted at the previous sale, but as he did not wish to occupy the time of "the room" with a long speech he would bring the matter to a practical conclusion by proposing the following resolution:—"That, inasmuch as the 608 bags pepper dust contain 44 per cent. of sand and clay, and would, therefore, subject retail dealers in the same to penalties under the Adulteration of Food Act, the buyers present protest against the proposed sale."

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* Whole grains of pepper, 1·00. Pepper leaves, husks, &c., 51·80. Sand and clay, 44·20.

The broker replied at some length, denying the allegations of Mr. Harvest as to the statements made by him on a former occasion, but the denial was met by general expressions of dissent. He remarked that he was at a loss to explain why Mr. Harvest should be so persistent in his opposition to the sale of an article which he did not buy, and the merchants for whom he acted at one time felt disposed to commence legal proceedings against him for his action in the matter. He would put the resolution to the meeting, but he might say at once that, whatever might be the result, he should sell the pepper dust. Only three hands were held up against the motion, when he immediately sold the 608 bags. The entire pile, divided into lots of twenty bags, was bought by a firm of brokers, who paid 2d. per lb. for the first lot and 1⅞d. for the remainder. Such a price, in the opinion of the *Grocer*, carries with it a sufficient condemnation of the article, when it is remembered that the very lowest quotation for the worst quality of pepper offering in the market lately has been no less than 4¾d.; and the most that can be said in favour of the sellers is that the pepper in question had not been tampered with by manufacturers here, but was sold in exactly the same state as it was imported, so that no attempts were made to conceal its objectionable and deleterious qualities from the notice of intending purchasers. Messrs. W. & D. Harvest write: "Possibly the pepper dust may go to feed fowls, but should it reach the hands of unscrupulous dealers we fear the public interests will suffer."

SULPHATE OF ALUMINA FROM BAUXITE WITHOUT TRACES OF IRON.

O. Falberg in conjunction with Semper, claims to have practically solved the problem of preparing sulphate of alumina free from iron in bauxite ores by the use of lead peroxide which is prepared by first triturating a mixture of 2 parts lead monoxide and 1 part sodium chloride, until the mass assumes the white tint of lead oxychloride; the product is then boiled with bleaching powder until lead peroxide is formed, which is washed and preserved in the damp state. This paste is added to a neutral or slightly alkaline solution of bauxite in sulphuric acid; for every part of iron contained in the solution 20 parts of the dioxide are required. It is necessary to work with concentrated solutions and to avoid a rise of temperature; the iron must also be as a ferric salt. In order to recover the peroxide employed, the solid matter is separated by a filter-press, suspended in water, and then dilute sulphuric or nitric acid added, which leaves the peroxide undissolved, so that it can be employed a number of times without losing any of its properties.—*Bul. Soc. Chim.*

ADULTERATED AND SPOILED TEAS.

The House Committee of Ways and Means for the United States reported favourably, January 23, a bill prohibiting the importation of teas adulterated.

This prohibits the importation of teas adulterated with spurious leaf or with exhausted leaves, or containing chemicals or other deleterious substances making them unfit for use. All tea imported is to be examined, and if it is found to come within the prohibitions of the act, the importer or consignee must give bond to export it within six months. In case of failure to do this, the collector must cause the tea to be destroyed. The term "exhausted" is defined to include any tea which has been deprived of its proper strength by steeping, infusion, &c. This provision is intended to exclude teas that have been once used and then manipulated to be sold again.

This decision of the committee was materially influenced by a statement made by Mr. J. R. Davies, who has been for many years in the tea trade. Mr. Davies exhibited samples of worthless and adulterated teas which had been put upon the New York market, "teas" which had sold elsewhere from 4 to 8½ cents a pound. The enactment of a law in England prohibiting the importation of all adulterated teas, including all tea whose chemical properties are injurious to health, has had the effect to divert an immense quantity of these teas to the American market. In 1881 over 44,000 packages were forbidden entry into England and were exported, part of them coming to this country. Such importations should be stopped at the custom house or destroyed, as is done in England.—*Scientific American.*

ADULTERATION CASES AT SOUTHWARK.

The following cases were heard at the Southwark Police Court lately.—

The vendor of a butter (3) was prosecuted by the Inspector of the St. Saviour's District Board of Works.

The certificate was as follows:—Light orange yellow. Clean. Uneven in polarization, as seen under microscope, no crystals.

Water	10·11
Salt	1·65
Matter insoluble in ether	1·67
Fat	86·57
	100·00

Melting point, 33°. Actual density, 0·9104.

Insoluble fatty acids } 90·22
90·46

This butter is not of the nature and quality demanded. It has about 20 per cent. of added fat.

The butter was referred to Somerset House, and came on for hearing before Mr. Slade on the afternoon of the 14th instant. Dr. Bernays appeared and asked permission to make a statement after the Somerset House report had been read.

In the report, the examination of the butter gave the following results:—

"Water	8·21
Salt	1·44
Curd	1·41
Fat	88·94
	100·00

"From the results of a full analysis of the fat we are of opinion that the butter is genuine."

Dr. Bernays protested that such a certificate was insufficient to establish the genuineness of the butter, and that no magistrate could form a judgment from such loose expressions. Had the referees given the analysis, we might have had a standard for genuine butter. The magistrate had probably read the report of Dr. Sedgwick Saunders, the Public Analyst for the City of London, in which he rightly complained that the specially appointed referees and censors in the government department at Somerset House had not seen fit to publish standards of purity.

The magistrate quite agreed with the reasonable request that the censors should publish standards, and suggested that Dr. Bernays should address himself to the Home Secretary.

The solicitor for defendant desired to say nothing more than that doctors differed. He would not ask for his expenses.

The summons was dismissed with costs for £1 1s. for the Somerset House analysis.

On the same day, and after adjudication of the above case, a disputed milk case was brought forward for hearing.

The Inspector for St. Saviour's, Southwark, had produced the following certificates:—

(1) Milk. Specific gravity, 1030. Cream, 6 per cent.

Total solids	10·72	10·78
Water	89·28	89·22
Fat	3·10	3·18
Solids not fat	7·62	7·60
	100 00	100·00
Ash	0·69	
Salt	0·16	

This milk is not of the nature and quality demanded. It has at least 10 per cent. of added water.

The case, referred to Somerset House, brought the following certificate:—

" Solids	7·21
Fat	3·15
Water	89·64
	100·00
Ash	0·66

" This milk has not less than 10 per cent of added water."

Dr. Bernays was permitted to point out that in the case of milk, the ground was much safer, as the opinions of the referees were fairly understood, although not agreed to.

The magistrate fined the defendant £1 1s., including costs.

LAW REPORTS.

Butterine :—

At Southwark Police Court lately, Mr. Jeremiah Pender, cheesemonger, carrying on business at 18, Long Lane, Bermondsey, was summoned by Mr. Edwards, the sanitary inspector in the employ of St. George's Vestry, for selling as pure butter a mixture called butterine. John Niblett, a labourer in the employ of the Vestry, said that on the 5th Dec. he was instructed by Mr. Edwards to purchase a half-pound of 14d. butter at defendant's shop. He entered the shop and asked for that, and was served by an assistant from a slab. He paid 7d., and handed the package to Mr. Edwards, who then entered the shop. In answer to the defendant, he said there was no ticket over the material from which he was served on which was inscribed " butterine." He asked for butter. John Edwards, the inspector, said as soon as the butter had been served he took it from the last witness and told the defendant's assistant he had bought it for analysis, and divided it in three portions. He left one in the shop, and took one to Dr. Muter for analysis, and he now produced his certificate, setting forth that it consisted of animal fat manufactured to resemble butter, and not injurious to health. The defendant, in answer to the charge, said that the material from which the man was served had a ticket over it marked " butterine," and that was asked for. He had butter at 14d., but it was not liked so well by his customers as the " butterine." It was not his practice to deceive the public. Mr. Slade told him it was quite clear from the evidence of Niblett that he asked for 14d. butter, and if defendant did not keep that he should have told the man it was " butterine." He fined him 5s. and 12s. 6d. costs.

Important Decision on Appeal "As to Dilution of Spirits" :—

Gage *v.* Elsey.—This case raised a question under the Adulteration Acts—whether it is an offence to sell spirits as "diluted," and of no particular alcoholic strength; which, in fact, is mixed with water to a greater extent than allowed on the sale of an article as spirits. The question had arisen under these circumstances, as stated in the case:—William Gage, the appellant, is a publican, at Braintree, in Essex; the respondent, Thomas Elsey, is the superintendent of police for the Braintree district. On the 11th of August, 1882, the respondent went to the appellant's house, and asked for some "gin." The appellant said "What sort." The respondent replied "The same as you sell to the public -what is that in that cask?" pointing to a cask. The appellant said "Gin, but you see our notice." This notice was a large notice hanging up in the bar to the effect that all spirits were sold as "diluted," and no alcoholic strength guaranteed. The respondent replied that he saw it, and wanted three pints of gin from that cask. It was supplied to him, and he had it analysed. It was found to be diluted to the extent of 40½ deg. below proof, which is 5½ deg. below the *minimum* strength of gin, allowed by the Adulteration of Food Act, 1879, to be sold as pure gin. The respondent summoned the appellant before the justices, and he was convicted and fined £2 and costs. This was an appeal from that decision. Mr. C. E. Jones argued for the appellant, and Mr. Grubbe for the respondent. Mr. Justice Manisty said there was no fraud in the case, and no evidence of fraud; if there had been it would have been different. A mixture might be sold if not to the prejudice of the customer or fraudulently, so as to conceal its nature or quality. Under the Act of 1875 it might be sold with a notice or a label indicating what it really was, and here there was express notice of it; and the provision in the Act of 1879, that there must not be dilution below a particular strength in order to justify a sale as spirits, had no application to the present case. The article certainly could not be sold as spirit, yet it might be sold as "diluted" spirit under the Act of 1875. Mr. Justice Mathew concurred. The conviction accordingly was quashed.

Coffee and 60 per cent. Chicory :—

At Southwark Police Court, very recently, Richard Lands, general shopkeeper, 52, Esmeralda Road, Bermondsey, was summoned by Mr. Thomas the sanitary inspector of Bermondsey, for selling as pure coffee a mixture containing 60 per cent. of chicory. Mr. Harrison, vestry clerk, prosecuted. Mr. Thomas said that on November 28th he caused a quarter of a pound of 16d. coffee to be purchased at defendant's shop, and at the same time he told the defendant that he was going to have it analysed. Witness divided it into three portions, and took one to Dr Muter, who forwarded his certificate (produced) showing that it contained 60 per cent. of chicory. The defendant said that he had just taken the business, and did not know the coffee contained so much chicory. Mr. Slade fined him 40s. and 12s. 6d. costs.

Butter and Fat :—

At Woolwich Police Court, recently, Mrs. Hopperton, a shopkeeper at Plumstead, was summoned by the District Board for selling adulterated butter. James Connell, the inspector, said that he asked the defendant for 10 ozs. of 16d. butter and paid her 10d. for it. He divided it in the usual way, and sent a sample to Mr. Wigner, public analyst, who certified that more than half of it was some kind of fat, not butter. Defendant said that she bought the butter of a wholesale dealer in the Borough, and produced his invoice to prove that she paid 13½d. per lb. for it. It was therein described as butter, but the same invoice related to butter of a superior quality and also to some inferior, described as "roll" butter, but which she said was generally called "bosh" Mr. Balguy said that butter which originated in the Borough could not be expected to come from the cows, and he was surprised that dealers did not know where to get a pure article which they could sell at a profit for 16d. a pound. Plenty of such butter could be got from the country and from France, without resorting to fat and filth and the refuse of the Borough Market. The defendant, who had given the name of the firm which supplied her, said that the analyst ought to take samples at the fountain-head. Mr. Balguy concurred, and fined her 20s. and costs.

Watered Lard :—

At the Salford Police Court, lately, Mr. Samuel Hardy, provision dealer, 86, Broughton Road, was summoned for selling "watered" lard. Mr. Walker prosecuted, and the defendant was represented by his wife. On December 5th, Inspector Thompstone purchased at the defendant's shop one pound of lard, for which he paid 8d., the price at which pure lard was then being sold. On being analysed, the lard was found to be adulterated with 16 per cent. of water. Defendant was fined 10s. and costs.

Coffee Adulteration :—

At the Stourbridge Police Court, before Colonel Fletcher and Messrs. H. O. Firmstone and J. Turney, Mr. Alfred Tandy, grocer and provision dealer, Belbroughton, was summoned for violating the Sale of Food and Drugs Act by selling adulterated coffee. Superintendent Wheeler stated that coffee was purchased at the defendant's shop, which, upon being analysed, was found to contain 40 per cent. of chicory. Defendant said the article was sold as a mixture of chicory and coffee, but this was denied by the officer. The magistrates imposed a fine of 10s. and costs. Superintendent Wheeler stated that he thought it was only right he should inform the Bench, that although between thirty and forty tradesmen had been visited, it had only been found necessary to summon five for adulterated articles Colonel Fletcher said the officer's statement was very satisfactory, as it showed that the tradesmen endeavoured to act honourably towards their customers.

Milk Adulteration.—Ingenious Excuses :—

Walter Peters, a milkman, of Cavendish Road, Tottenham, was summoned in respect of milk adulterated with 20 per cent. of water, which was sold in the street by a boy to Mr. S. A. Smith, the inspector appointed under the Act. It was stated that the boy was employed by a man in the service of the defendant. Mr. H. R. Jones, who defended, said the boy was not in the employ of his client. He asked the magistrate whether he thought that carried agent to agent. Mr. Sheil thought it did, otherwise the Act would be a nullity. The inspector said that it was the third time the defendant had been fined. Mr. Sheil now fined him £10 and 14s. 6d. costs.

Ezekiel Osborn, a milkman, of Tooting Pavement, was summoned for a similar offence; the milk being sold to the inspector, and having 26 per cent. of water in it. The defendant said it was frosty weather at the time, and the cows had been feeding on mangel-wurtzel, which would cause the milk to be watery. Mr. Sheil thought there would be less water in frosty weather, and imposed a fine of 20s. with 14s. 6d. costs.

James Austin, of Gervais Street, Old Kent Road, was summoned by Inspector Fisher for selling milk adulterated with added water to the extent of 34 per cent. Upon Mr. Chance asking the defendant what he had to say to the complaint, he replied that the offence took place during Christmas time, and that he could not get milk enough to supply his customers. Mr. Chance said by that argument customers at Christmas time were to be supplied with milk and water, but at the same time pay milk price. Defendant still declared that sufficient milk could not be obtained at Christmas time. Mr. Chance said such a defence would not be sufficient for him, and ordered the defendant to pay a fine of £2 and 12s. 6d. costs.

ANALYST'S REPORT.

The annual report of the Bradford borough analyst, Mr. F. M. Rimmington, F.C.S., is as follows:— I have the honour to report to you the results of the operations of the Adulteration Acts for the year ending December 31st. Eighty-five samples of the following articles of food have been submitted by Inspector Chambers for analysis. These consisted of sixty-six milk, six pepper, six sago, one table sauce, one essence of coffee, one cream, one rum, two butters. Of these nine milk, one rum, and two butters only were adulterated. With the exception of the nine adulterated samples the others were nearly all of them excellent milk. The rate of adulteration on the whole list is 14 per cent., and on the milk alone 13½ per cent. These results have been most favourable, in comparison with those obtained in other large towns, and the inhabitants of the borough may be congratulated upon having a supply of very good milk. In addition to the work done under the Adulteration Act, it has been necessary as a consequence of the extension of the boundary of the borough to examine the waters from various pumps and wells in the villages, from which many of the inhabitants procured their supply. Ten such samples have been analysed and reported on.

Butterine.—At a meeting of the Somersetshire Chamber of Agriculture held at Bridgwater, the subject of adulteration was discussed. Major Harbin, the chairman of the Chamber, said the whole question of adulteration was very difficult, and they wanted to have articles called by their proper names. A short time ago some farmers of Somerset wished to be satisfied relative to the value of analysis, and they bought some butterine and sent it to an analyst, and did not say what it was, but with the request, "Analyse this for us." The analyst sent back that it was a very good specimen of butter indeed, whereas it was butterine.

RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

No 1883	Name of Patentee.	Title of Patent.	Price
1642	W. H. Akester	Incandescent Electric Lamps	6d.
2554	J. H. Johnson	Vulcanizing India Rubber	4d.
2560	S. Hallett	Electric Lamps	4d.
2569	T. E. Gatehouse and H. R. Kempe	Ditto	6d.
2595	W. Boggett	Materials for Secondary Batteries	2d.
2642	Sir C. T. Bright	Secondary Batteries	4d.
2613	W. E. Ayrton and J. Parry	Electric Lamps	6d.
2613	W. E. Ayrton and J. Parry	Registering amount of Work given Electrically to any part of an Electric Circuit in a given time	4d.
2654	R. J. Hatton and A. L. Paul	Electric Lamps	6d.
2658	A. Muirhead	Secondary Batteries	4d.
2659	W. B. Brain	Primary and Secondary Batteries	2d.
2664	G. W. Van Nawrocki	Manufacture of Sulphide of Sodium	2d.
2674	E. de Pass	Electric Lamp	4d.
2676	A. M. Clark	Preparing Electrodes for Secondary Batteries	4d.
2682	H. Aitken	Treating Carbonaceous and other Substances to obtain Products therefrom	1/2
2686	M. A. Wier	Electric Lamps	2d.
2688	C. G. Gumpel	Voltaic Batteries	2d.
2706	Mr. J. Stuart and J. Elliott	Treatment of Ores	6d.
2708	F. J. Bolton	Treatment of Celestine and Sulphide of Strontium for production of Caustic Strontia and Carbonate of Strontia	4d.
2709	F. J. Bolton and J. A. Wanklyn	Treatment of Gases containing Ammonia for Production of Artificial Manures	4d.
2712	W. R. Lake	Electric Lamps	6d.
2722	A. P. Price	Secondary Batteries	2d.
2723	C. G. Gumpel	Electric Lamps	6d.
2730	G. R. Hislop	Treating Waste Lime for Sulphur Compounds	4d.
2734	J. Mathieson	Governing the Feed of Electric Air Lamps	6d.
2752	J. Lane	Electric Lamps	6d.
2755	W. Chadburn	Ditto	8d.
2756	C. G. Gumpel	Voltaic Batteries	6d.
2759	H. H. Lake	Electric Lamps	6d.
2807	L. Epstein	Secondary Batteries	4d.
2836	W. R. Lake	Manufacture of Nitric or Nitro Compounds for Explosive Purposes	8d.
2845	A. Pfannkuche	Incandescent Lamps	2d.
2901	J. T. Sprague	Electric Meters	4d.
3070	E. de Pass	Electric Air Lamps	6d.
4930	C. S. Snell	Ditto	6d.

BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; Journal of Applied Science; The Provisioner; The Practitioner; New Remedies, Proceedings of the American Chemical Society; Le Practicien; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Canada Lancet; Gas and Water Engineering; The Grocers' Gazette; Columbia School of Mines Quarterly Magazine London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Brewer, Distiller, and Wine Manufacturer (Churchills).

THE ANALYST.

APRIL, 1883.

SOCIETY OF PUBLIC ANALYSTS.

A General Meeting of this Society was held at Burlington House, on Wednesday, the 14th March, the President, Mr. Wigner, in the chair.

The minutes of the previous Meeting were read and confirmed.

The ballot papers having been opened, it was reported that the following gentlemen had been duly elected as Members: Dr. C. R. Alder Wright, F.R.S., Mr. A. W. Duncan, Mr. W. J. Williams, and Mr. H. Crook.

The following were proposed for election, and will be balloted for at the next Meeting: Mr. W. Fox, Analytical Chemist, London, and Dr. Davenport Hill, Public Analyst, Massachusetts.

The following papers were then read:

"Note on Selenium as an Accidental Adulteration of Commercial Sulphuric Acid," by Dr. Drinkwater.

"Note on a New Form of Ether Apparatus," by J. West-Knights, F.C.S.

"On District Standards in Water Analysis," by A. Dupré, F.I.C., and O. Hehner, F.I.C.

The next Meeting of the Society will be held at Burlington House, on Wednesday, the 18th April.

ON DISTRICT STANDARDS IN WATER ANALYSIS.

By A. Dupré, Ph.D., F.R.S., F.I.C., and Otto Hehner, F.I.C.

Read before the Society of Public Analysts on 14th February, 1883.

The question of a standard by which to judge the quality of any particular sample of water has frequently been discussed, but as yet no generally satisfactory conclusion has been arrived at. Several standards have indeed been proposed, but none has been generally adopted, and we cannot say that we regret this result. The laying down of any one general standard by which to judge the great variety of waters met with in different parts of the country and in different geological formations is, in our opinion, at once impossible and undesirable. Impossible, because a given proportion of certain constituents for example which, when found in a water of one district, would be sufficient to condemn such water, might be admitted as perfectly harmless in a water from another district or source; undesirable, because such a standard in great measure weakens the feeling of personal responsibility of the analyst and by giving a spurious belief in the possession of knowledge to the ignorant frequently leads to error and the lasting discredit of analysts in general. No doubt, no chemist of experience in water analysis would be led into error by such a standard, but then he would not require a general standard at all, but shapes his opinion according to the circumstances of every particular case. On the other hand, analysts with little or no experience are but too ready to fall back upon standards and judge everything rigidly according to such; they will confidently pronounce a water to be pure because it yields less ammonia and albuminoid ammonia than the standard supplied to them permits, or will as confidently, and as unreasonably, condemn a water because it yields more of these than their standard allows.

This difficulty as to standards is certainly by no means confined to water analysis, but comes up whenever a standard is laid down for a natural product liable to variation. Bread will be pronounced adulterated with alum because it contains a little more alumina than some one has stated to be the standard proportion; and milk will be condemned as mixed with water, the proportion of water added being calculated even to one-tenth per cent., because the solids not fat fall a little below an adopted standard.

Now, what we wish to impress on our fellow analysts is this—by all means take into consideration and, on suitable occasions, make use of such general standards as have been laid down by chemists of high ability and large experience; but use these standards cautiously and with discrimination, and judge every case on its own merits. Analysts who lack either the ability or the experience to stand on their own legs, and slavishly adopt standards laid down for them by others, have no business to meddle with water analysis at all, and the sooner they leave such work to their more experienced brethren the better it will be for themselves and for the credit of water analysis.

But it may be asked, if general standards are of little or no use, how are we to judge of the fitness, or otherwise, of any given sample of water? Our answer is, by its conformity to, or divergence from the general character of the waters of the district from which it comes, or the geological formation from which it springs, which from their surroundings may fairly be taken as unpolluted. In other words, have district standards instead of a general standard. One advantage of such a standard, though not a chemical one, we should like to point out. Whenever the question of closing a well by legal action arises, the court before which the case comes has to be convinced of the unfitness of the water complained of. Now nothing so readily shows this as our ability to prove that the water departs, in the direction of impurity, from the waters of the district.

One of us brought this subject before the Society some years ago, but although the Society took some action, it was not exactly in the direction indicated. The work then started has now been brought to a satisfactory conclusion, and we, therefore, once more revert to the original proposition.

There are, of course, some waters which we are at once justified in pronouncing as either fit or unfit, as the case may be, for domestic use. But this is not the case with the great majority of waters, and in order to judge these correctly, other facts, besides the mere results of analysis, have to be taken into consideration, of which one of the most important is the general character of the unpolluted waters of the district. Few analysts, however, have a sufficiently minute knowledge of the character of the water supply of the entire country to be able to apply their local knowledge in the case of every water sent to them for analysis, and it is here that a society such as ours might, in our opinion, fitly step in and supply the deficiency.

We are fully conscious of the objections that may be raised against our proposition, but we also believe that, on consideration, such possible objections will by no means outweigh the advantages every analyst would derive from it. Chemists of skill and experience will always command the main share of the work that is to be done in their own district, and will lose nothing by communicating their local knowledge to others outside the district. They will undoubtedly thereby confer a benefit on others, but in their turn they will benefit by the knowledge of others likewise made common property, and thus the balance will be kept even.

Our proposition then, shortly stated, is this: "Let the Society appoint a committee which, in the first place, would invite our members to send in all analyses of waters collected in their districts, which from personal knowledge they consider as unpolluted, together with a few instances of polluted waters, and in the second place arrange and publish the results in The Analyst."

There can, we take it, be little doubt that, if they will only fairly fit themselves for the task, the greater part of the general analytical work of the country will, in process of time, fall into the hands of Public Analysts. Much, however, remains to be done before such a point is reached, but meanwhile a society like ours could greatly facilitate progress towards such an end if only its members would bear in mind that here, as elsewhere, union is strength, and would heartily co-operate with each other in the advancement of knowledge.

As a small contribution to the proposed collection of district standards, and in the hope of starting the movement, we give a series of analyses of waters from the Isle of Wight, which we hope will show not only the utility of our proposed district standards, but will also illustrate the danger of judging a water by any general rule regardless of surrounding conditions.

In the following Table (I.) Nos. 1 to 12, ranged in the order of their position along the chalk downs and cliffs from Shanklin to Blackgang (a distance of eight miles), may be taken as illustrating the composition of the unpolluted water supply of the district. In Table II., Nos. 13—20, we give a few more or less polluted samples from the same district. The whole of these samples, most plainly polluted, as a comparison with Table I. will show, would have passed more or less readily the test of any arbitrary standard.

TABLE I.

GRAINS PER GALLON.

	1878.		July, 1880.							April, 1881.		
	1	2	3	4	5	6	7	8	9	10	11	12
	Shanklin Public supply.		The Maples, Bonchurch.	Last House in Bonchurch, Ventnor end.	Borrills Lodge.	Ventnor Water Works, from tunnel.	Grove Road.	Terrace House.	Steephill Castle.	High Road, above St. Lawrence.	St. Lawrence Well.	Rocken End.
Chlorine	2·13	2·70	3·04	2·97	2·44	2·19	2·59	2·72	3·05	3.50	5·85	4·18
Sulphuric Acid	·36	·80			·81	·69	·79	·55				
Nitric Acid ($N_2 O_5$)	·62	·43	·33	·32	·45	·64	·59	·34	0·59	·47	0·45	0·10
Free Ammonia	·004	none	·001	·001	·001	·0	·001	none	none	none	none	none
Albuminoid Ammonia	·002	·003	·001	·001	·001	0·001	·001	none	none	0 0017	0·0022	0·0014
Total Solids	20·50	22·82	21·0	22·68	24·67	25·00	24·27	22·59	22·31	28·56	31·92	24·08
Loss on ignition										2·80	2·24	1·12
Hardness, total	12·9	14·1	14·8	14·9	17·0	17·2	16·7	14·3	15·5	19·	19·	16·
,, permanent	2·7	3·0	3·4	2·9	3·0	3·0	3·0	3·6	2·7	4·	6·	9·8

TABLE II.

GRAINS PER GALLON.

All January, 1881.

	13 Bonchurch Well.	14 House in St. Boniface Road.	15 House on Spring Hill.	16 Same, two years later.	17 Well in Hill Street.	18 Inn in Albert Street.	19 Cottage in Albert Street.	20 Slaughterhouse.
Chlorine	6·32	3·47	3.37	3·08	4·62	4·55	5·88	4·20
Sulphuric Acid		1.32	1·85	1·19	4·62	2·54	3·99	1·87
Nitric Acid	3·86	·89	1·88	1·02	1·98	3 71	3·78	1·47
Free Ammonia	none	none	none	·0005	·001	0·0002	0·0004	·0056
Albuminoid Ammonia ..	0·0021	none	·001	0·003	·004	0 0007	0·0030	·0049
Total Solids	36·98	23·47	30·05	27·02	44·43	39·9	41·23	32·69
Loss on Ignition	2·52							
Hardness, total	18·	16·3	17·	16·8	20·7	22·4	23·3	18·5
,, permanent ..	8·5	3·9	4 5	3·6	3 4	8·3	6·7	5·2

In reference to the polluted waters, 13—20, a few explanatory remarks may be of interest.

13. Above the well, not far distant from it, are situated deep cesspools sunk in the chalk.

14. The conclusion drawn from comparison of this water with its immediate neighbours, namely, that it is somewhat polluted, was strikingly borne out by a careful investigation of the surroundings of the well, an old cesspool being found in its immediate proximity.

15. Well in a little yard, surrounded by houses and stables.

17. Stables close to well.

18. Much frequented urinal within 3 yards from well. The complete oxidation of the ureal ammonia is remarkable.

19. Donkey shed without drains almost on the top of well.

20. Well in slaughterhouse, organic refuse in abundance.

TABLE III.

GRAINS PER GALLON.

	Feb. 1876. Newport Public Supply	Feb. 1883. Well near Newport.	April 1881. Carisbrooke Castle Well.	July 1861. Norman's Land Fort.	July 1881. St. Helen's Fort	July 1881. Spit Bank Fort.	July 1881. Horse Sand Fort.
Chlorine	2·23	2 09	5·42	13·02	7·98	2·87	5·32
Sulphuric Acid	·36	2·88					
Nitric Acid	1·07	·42	5·99	trace	trace	trace	trace
Free Ammonia	0·003	0·004	0·0129	0·075	0·004	0·039	0·070
Albuminoid Ammonia	0·003	0 005	0·0070	0·004	0·003	0·001	0·001
Oxygen absorbed in ½-hour..			0·0252	0 014	0·010	0·008	0·000
Oxygen absorbed in 4 hours			0·0686	0·014	0·018	0·018	0·009
Total Solids	22·28	26·95	37·80	37·80	27·16	22 68	23·52
Loss on ignition		2·17	2·52	1·40	1·40	0·56	0·84
Hardness, total	15·	15·	16·	8·	8·	3·	5·5
,, permanent	3·	6·3	5·5	2·	2·5	1·	1·5
Phosphoric Acid...........		strong trace	strong trace	trace	minute trace	trace	minute trace

As, perhaps, of general interest, and in a measure connecting the waters of Table I. with the water on the neighbouring mainland coast, we give in Table III. analyses of the Newport supply, of the water from the deep well at Carisbrooke Castle, and finally of waters from the four iron Forts at Spithead. The wells supplying these forts occupy, we believe, a unique position in England. They are sunk on artificial islands, at a considerable distance from the shore, and though many hundreds of feet in depth pass entirely through sand and gravel. The most notable feature in these waters is the very large amount of ammonia they contain, and, considering their source, the small proportion of chlorine. The latter fact proves, that in spite of the permeability of the overlying strata, little or no sea water finds its way into the well, being evidently kept out by the superior pressure of the fresh water derived from the high collecting grounds of the adjoining mainland. The well at Norman's Land Fort is 568 feet deep, measuring from high water mark. Water rises to within 1′4″ from level. Stratum . loose, sharp, light grey sand, and a little clay.

St. Helen's Fort Well is 172′ in depth, water rising to 6 feet from the water mark. Stratum: dark sand and clay.

Spit Bank Fort: depth of well 395′6″, the water rising to within 1′10″ of high water mark. Stratum: fine grey sand.

Horse Sand Fort: depth of well 565′8″ below high water mark, water rising to within 1′17″. Stratum: clear sharp light grey sand.

The distance from Spithead to Shanklin is about 10 miles.

The analyses being made at different times, the amounts of sulphuric acid, "oxygen absorbed," and "loss on ignition," were not taken in every case.

In conclusion, we can only express our willingness to aid the Society to the best of our ability in any steps which they may wish to take in the direction indicated in our paper.

Mr. Hehner said that he was of opinion that it was a great mistake to call nitric acids previous contamination. There were cases of wells which contained no free or albuminoid ammonia, or practically none, but yet were evidently polluted from cesspits close to the wells. In some cases the nitric acids came to 15 per thousand, and it would be called old contamination, yet it was as recent as could be. He was convinced that under favourable circumstances even filtration through three or four feet of soil would so completely remove all organic matter that the water would readily pass the various arbitrary standards which had been laid down.

The President congratulated the Society on having another valuable paper at its second meeting this year, and pointed out that the curious fall in nitric acid in sample 11 might be attributed to that well being on the other side of a very extensive fault. With regard to salt infiltration, he thought it was salt spray as well, and gave two illustrations in the case of Gibraltar water. One was from a tank situated at a large convent there—the tank was a well concreted solid tank, and yet he had known the water to contain 175 grains of salt per gallon. Again, one half of Gibraltar consists of lime stone rock, which had probably been thrown up some time or other, and it contained 80 grains of salt per cubic foot, and, therefore, it was not to be wondered at that the water was salt. As to the members of the Society giving them some district standards, he said by all means let them do so.

Mr. Bernard Dyer said that everyone must agree with the President that the paper just read was a most valuable contribution to the literature of the Society, and the latter portion of it formed a very interesting contribution on the subject of nitrification, upon which so much light had lately been thrown. With regard to the suggestion as to district standards, it would no doubt be a highly useful thing if they could get country members to send them. It was true that in some instances country members had objected to do anything of the kind on the ground that it would interfere with their local practice, and place local statistics at the disposal of other analysts, but he was sure there were advantages which should quite outweigh those ideas, even from the most selfish point of view of any member, and if anything of the kind were done, Mr. Hehner and himself as secretaries would be very pleased to undertake any work which might be thrown upon them in connection with the matter.

ON SO-CALLED "PREVIOUS SEWAGE CONTAMINATION."

By A. Ashby, M.B., and Otto Hehner, F.I.C.

Read before the Society of Public Analysts, on March 14th, 1883.

In the paper by Dr. Dupre and one of us read before this Society last month, a striking instance was given of the rapidity with which sewage is deprived of its organic constituents by filtration through soil, and it appeared to us that it would be of importance to multiply evidence of this sort by giving further illustrations of this observation. With this object in view we have made exact local observations of the surroundings of wells from which various waters we have analysed have been derived.

We have purposely selected such analyses as show a very large amount of nitric acid, little free ammonia, and small or moderate quantity of organic matter, as indicated by the albuminoid ammonia.

The examples have, with one or two exceptions, been taken from districts with which one or the other of us is specially familiar. The towns of Derby and Newark-on-Trent, which are both situated on the variegated marl of the Trias, with here and there alluvial gravel deposits, have furnished the greater number of them, the Marlstone Rock bed of the Middle Lias, and the chalk furnishing a few others.

The nitric acid is unusually high in many of the Newark waters. Here the surface wells vary in depth from seven or eight to twenty or twenty-five feet, but few are so deep as twenty feet The wells are fed with surface water. In all instances the contamination of the waters has its origin at very short distances from the wells themselves; many of the waters were specially examined, because they were plainly the medium by which typhoid fever had been spread. From the position of the wells and the distance of the polluting sources from them, it is quite plain, that the pollution cannot be accurately termed "*previous*," but that perfectly recent sewage continuously finds its way into the wells.

The nitric nitrogen, though approximately measuring the amount of the *sewage contamination*, cannot in any way be held to indicate the proportion of *previous sewage contamination*.

In these localities we have very seldom found waters with any large quantity of free ammonia, and in many wells under almost identically the same conditions with respect to the liability to pollution, we have many times found waters with high nitrates, but in which much less oxidation of the organic matter has taken place. In newly made wells situated in more recently inhabited parts, the oxidation is often less complete, the polluting organic matter being less changed into nitrates; but when the surrounding ground has become well saturated with sewage matters, and has become converted into a nitre-bed as it were, then the oxidation is carried much further; yet surely it cannot with any reason be urged that water which has passed through such a sewage befouled soil is likely to be the less dangerous on that account, notwithstanding that much of the organic nitrogen may appear as nitric acid instead of in its original form. In the Newark series, the nitric nitrogen amounts on the average to about 7 in 100,000, whilst the albuminoid ammonia nitrogen, which, by the way, does not represent the whole or even a constant proportion of the organic nitrogen left in the water, amounts to only about ·001, 7,000 parts have therefore been oxidised and only one left, which shows that this residue is of a different and far more permanent character than the bulk, and we maintain that this remainder of organic matter, however small it may be, representing in all probability the organised and living part of the polluting matter, may be a most potent agent as a disease carrier. Therefore it matters not whether it appears in the analytical results as 0·1 or 0·0001, or any less quantity; the opinion of Dr. Tidy, that the greatest danger lurks in the readily oxidisable matter, notwithstanding. It follows that greater significance attaches to minute quantities of organic matter, when accompanied by any excess of chlorine, nitric, phosphoric and sulphuric acids over and above the normal standards belonging to the natural unpolluted water of the geological formation from which the sample under examination may have been taken, than when the substances mentioned are normal in amount. In other words, we should rather judge the quality of a water by the mineral constituents enumerated, than by the organic indications, readily changeable as they are.

Bacteria and germs probably resist oxidation to a far greater extent than putrescible effete animal matter: they are, in fact, probably the agents by which those substances are nitrified. They would furnish in the analysis an amount of organic carbon and nitrogen, or of albuminoid ammonia, may be, in the third or fourth place of decimals; yet surely, since they are the morbific agents, the danger is none the less if those figures are small. We found the amount of albuminoid ammonia yielded by a *Daphnia pulex* to be represented in an ordinary distillation by ·0005 in 100,000, yet how many bacteria or other germs would it not take to furnish as much organic matter as existed in that entomostracan? Doubtless many more than would suffice to communicate disease.

It has devolved upon one of us, to examine some water which had poisoned and nearly killed several beasts and horses. It was proved to be loaded with arsenic, which had found its way into the well through some oolite limestone from a crew yard nearly fifty yards off where some arsenical sheep dipping had been thrown away.

Again, a gentleman, who had had scarlet fever in his house, put some carbolic acid into his privy vault to disinfect it, with the unpleasant result of nearly poisoning some of his friends, who were about to partake of his whisky and water, but who were deterred from drinking it, owing to its highly disagreeable flavour, for which they were at a loss to account. Their host readily recognised this as due to the carbolic acid which had travelled from the privy into his well, a distance of about fifty yards. This leads us to ask, if those substances can percolate so far through the ground, is it not more than probable, that disease germs may not travel at least an equal distance, although most of the more easily oxidisable putrescent effete substances may have become more or less changed into nitrates on the way?

We have long felt, and have acted on the opinion, that chemical analysis of water may furnish valuable *positive*, but not *negative* evidence of pollution, and it is highly gratifying to us, that this is so strongly insisted upon by Dr. Buchanan in his remarks upon Dr. Cory's investigation on waters prepared for analysis by intentional pollutions, in the Eleventh Annual Report of the Medical Officer of the Local Government Board, and also to a great extent by Professor Mallet in a report to the National Board of Health, Virginia.

The results of the analyses are expressed in parts per 100,000.

DERBY WELL WATERS.

	Cl.	SO_3	$F.NH_3$	Alb. NH_3	N_2O_5	T. Solids	Distance of Sources of Pollution.
1	26·7	21·6	·0027	·0018	22·0	163·1	Adjoining farm yard and pig styes.
2	13·3	27·4	·0020	·0016	22·1	140·6	10 yards from privies, drain 18 inches distant, close confined yard.
3	6·7	13·7	·0020	·0047	14·5	101·8	10 yards from privies, drain 2 yards, garden.
4	12·5	40·8	·0010	·0147	11·2	168·4	7 yards from privies, drain 3 feet.
5	11·3	18·4	·0010	·0105	13·5	117·8	15 yards from privies, drain direct over well, paved yard.
6	10·9	21·4	·0020	·0165	25·7	129·6	7 yards from privies, drain 2 yards, garden covered with fowl pens.
7	6·8	32·9	·0045	·0080	11·3	130·2	3 yards from pail closets, drain 2 feet.
8	7·8	13·1	·0024	·0055	11·1	109·2	17 yards from privies, drain 2 feet, garden with fowl pens.
9	17·3	16·7	·0026	·0127	16·7	167·1	10 yards from privies, drain 2 feet, garden ground.
10	8·3	18·0	·0035	·011	27·7	145·8	13 yards from privies, drain 3 feet.
11	9·2	12·7	·004	·011	25·4	113·0	13 yards from pail closets, drain 2 feet, garden covered with fowl pens.
12	8·5	22·7	·002	·010	27·9	144·9	11 yards from pail closets, drain 3 yards, fowl pens.

NEWARK WELL WATERS.

Cl.	Oxygen absorbed in 4 hours at 80° F.	$F.NH_3$	Alb. NH_3	N_2O_5	T. Solids	P_2O_5	Distance of Sources of Pollution.
7·6	·2240	·0005	·0196	15·7	106·0	h.t.	Grate drain and ash pit 6 ft., w.c. drain 19 ft., large privy, 68 ft.
8·1		·0024	·0098	14·8	93·6	t.	Ash pit and w.c. drain close, drain 10 ft.
18·4		·0039	·0146	41·3	222·4	v.h.t.	Grate and drain 3 ft., privy 31 ft.
11·0	·0897	·0035	·0145	22·2	144·2	v.h.t.	Uneven open channel, grate and drain close, enormous privy vault for 12 houses, 18 ft. 6 in.
19·0	·0737	·0017	·0097	43·9	191·2	h.t.	Open channel from urinal over top of well, w.c. drain close, privy 11 ft.
6·6	·0204	·0025	·0058	13·7	94·2	h.t.	Gully and drain 3 ft., privies 60 ft.
12·9	..	·0023	·0150	31·7	169·8	h.t.	Uneven open channel, grate and drain close, 2 large ash pits 14 ft.
29·6	..	·0019	·0137	77·1	275·7	v.h.t.	Gully and drain 20 ft., enormous privy unemptied for three years 25 ft.
5·8	..	·0013	·0122	16·3	88·8	v.h.t.	2 gullies and drains 3 and 6 ft., privy 45 ft.
18·8	..	·0099	·0162	44·9	208·0	v.h.t.	Grate and drain 3 ft., ash pit 25 ft., privy 30 ft.
18·0	..	·0316	·0152	35·8	188·3	v.h.t.	Grate and drain close, w.c. 12 ft.
11·2	..	·0012	·0074	22·5	141·0	h.t.	Uneven surface channel close, privy vault 31 ft.
13·8	..	·0012	·0112	37·6	174·9	v.h.t.	Privy emptied once in 2 years, 13 ft., large ash pit 12 ft.
14·6	..	·0024	·0098	24·4	161·5	v.h.t.	Grate and drain 3 ft., w.c. drain 15 ft., large midden and urinal 47 ft.
6·3	..	·0013	·0190	18·4	107·7	v.h.t.	Privies about 30 ft.
12·6	..	·0021	·0084	27·2	160·5	v.h.t.	Privy 14 ft., uncovered ash pit 10 ft. 6 in., scullery drain 3 ft., w.c. drain 24 ft.
4·1	..	·0018	·0118	13·4	70·3	h.t.	Drain close, privies on each side 39 ft.
10·8	..	·0018	·0105	26·1	150·3	..	Gullies and drains 11 and 21 ft., privy 32 ft., cesspool about 50 ft.

OTHER WELL WATERS.

5·2	·0492	·0047	·0057	11·6	69·1	h.t.	Well 90 ft. deep in chalk, privy about 20 ft., cesspool 45 ft., old cesspool 30 ft.
21·9	·0631	·0047	·0118	19·0	140·6	h.t.	Uncovered ash pit about 15 ft., leaking sewer about 30 ft.
7·3	·0461	·0014	·0103	17·2	90·2	v.h.t.	Slop hole about 6 ft., privy and leaking sewer near.
4·1	·0266	·0009	·0041	9·8	84·3	t.	Well 22 ft. deep, privies 7 and 18 ft.

Mr. Kingzett, in referring to the question of the propagation of disease by germs, said, that soon after Dr. Tidy read his paper before the Chemical Society, he (Mr. Kingzett) called attention to some experiments he had made, which consisted of the estimation of the power of dilute extract of meat solutions of absorbing oxygen from permaganate. He found that at first the reducing capacity increased, whilst the solution became swarming with bacterial life, and subsequently the amount of oxygen absorbed became less and less. A single germ, incapable of being detected by analysis, might be capable of producing disease.

Dr. Dupré said, he did not think that the oxydation process had ever misled him, but of course the results obtained by its aid should be interpreted in the sense of the paper read recently by himself and Mr. Hehner. If a water conformed to the standard of the district or the geological formation, it might be regarded as pure. A fairly deep well water should absorb no oxygen, whilst a shallow well water generally did absorb more. If a deep well water absorbed only a fraction of the amount used up by the shallow well water, he should unhesitatingly condemn the former as polluted. Therefore, in judging of the amount of oxygen absorbed, the character of the well, its depth, geological formation, &c., had to be taken into account. As to the germ theory, he did not think that a *single* germ had ever produced disease ; it was very likely that it required a good many germs to do so in a healthy subject. He strongly protested against the permaganate process being designated, as was now so generally done, Dr. Tidy's process. Dr. Tidy had but very little to do with it, and it had been used long before him by a whole number of chemists.

Mr. Harland said that, as a rule, 90 per cent. of analysts had to give an opinion on a water without being able to obtain any information as to where it came from. He thought it was unfair to single out one test, and to say that that was of no value and no use, because on submitting it to certain unusual conditions, uncertain results were obtained. No commercial analyst would take one test and say the result is of no value, because when judged with the other results it might be of the utmost value. Analysts never condemned or passed a water on the oxygen absorbed—they might just as well do so on the total solids or salt. As to the germ theory, he suggested that the soil on which the germ fell might have something to do with the matter. Referring to the paper just read, with regard to the waters Nos. 3 and 4, he thought it very peculiar if those waters were contaminated with animal or sewage matter, that with the total solid matter of 101·8 and 168·4 the chlorine should be as low as 6·7 and 12·5.

Mr. Dyer said it was clear that the more they knew of water analysis, the more they saw the absolute fallacy of relying upon anything but a tolerably full examination. One member had said that analysts were not in the habit of relying upon one test: perhaps that was the case, thanks to the exertions of the Society during the last two or three years, but there were some persons—medical officers of health, &c.—who did undertake to examine waters and give an opinion upon isolated tests, and the permanganate process was the most fallacious as an isolated test. They knew that what at one time of the month was a normal proportion of oxygen absorbed, ceased altogether to be normal at another time. After Dr. Tidy had read his paper, he (Mr. Dyer), made a number of experiments on the permanganate test with New River water, purposely contaminated with urine and sewage, simply for the purpose of comparing them with the free and albuminoid ammonia tests, and he found that many of the waters which passed by Tidy's test would be condemned by the Wanklyn process. He thought the albuminoid ammonia process, although sometimes fallacious, was less apt to be so than the permanganate test. He would bring his experiments before the Society at the next meeting.

The President said that the main defect of the oxygen test, was that at present they had no readily available mode for obtaining the dissolved oxygen in the water. Many waters contained very notable quantities of it. It was without action at ordinary atmospheric temperature, but became active when the water was heated and very seriously affected the permanganate test proper. As to the analyses which had been referred to that evening, he was sorry that they had no information as to the character of the deposit. He firmly believed that if those wells were polluted with drainage, sewage, &c., a microscopical examination would have been sufficient to have given most convincing proof in many cases. In one case of his own, to which he alluded, he had detected by the microscope several unsatisfactory appearances in a water from a well 340 feet deep in the sandstone, and condemned it, with the result of raising a very violent storm among the inhabitants. Inquiries were made, and it was found that on the very day on which his sample was taken some plumbers had been down the well and had misconducted themselves.

Dr. Ashby said, that as none of them knew how many germs it would take to start typhoid or any other fever, the only proper course was to condemn any water which had a chance of containing them. Of all qualitative tests he thought the one for phosphoric acid the most valuable one. He was very much struck, on looking through Dr. Dupré's analyses, made or Dr. Cory, with the close connection between pollution and phosphoric acid, even when the amount of added pollution (excreta) was too small to be indicated by any other means.

Mr. Hehner, at the close of this discusssion, in which a number of other members took part, said that he was sorry to see that the paper which was supposed to be under discussion had altogether been lost sight of. He was, therefore, anxious to state in a few words the object he and Dr. Ashby had in writing the paper, and it was this, that from the proportion between free or albuminoid ammonia or from their amounts, or from the quantity of organic matter generally, no conclusion whatever could be drawn as to the age of the pollution; that sewage, fresh as could be, was present in the whole of the instances given in the paper, but that yet, in Dr. Frankland's expression, it would have been reported as "previous."

A Chemical Club has been formed in Manchester for the purpose of drawing together Scientific, Analytical and Manufacturing Chemists, and gentlemen connected with the Chemical trade. The rooms of the club are supplied with all the leading English and Foreign Journals. A valuable Chemical Library is in course of formation, and it is hoped that by such means technical chemistry will be benefited by the closer union of scientific chemistry. The President of the club is Mr. Ivan Levenstein, the well-known Aniline Colour Manufacturer, and the Secretary is Mr. J. Carter Bell, Analyst for the Borough of Salford.

NOTE ON SELENIUM AS AN ACCIDENTAL ADULTERATION OF COMMERCIAL SULPHURIC ACID.

BY DR. DRINKWATER, LECTURER IN CHEMISTRY, EDIN. SCHOOL OF MEDICINE.

Read before the Society of Public Analysts on the 14th March, 1883.

I HAVE had occasion lately to examine a number of samples of sulphuric acid which have been rejected by mineral oil manufacturers, and as some of the results are a little uncommon I have thought them interesting enough to lay before the Society.

The impurity most dreaded by the refiners of the products of shale distillation is nitric acid, which acts upon the hydrocarbons in one of two ways, either as an oxidising agent or as a producer of nitro substitution products, either of which actions spoil the product for commercial purposes.

Within the past three weeks I have received various samples of acid which were found to be damaging the oils, both by entailing loss on the finished product along with deterioration in quality. These samples were all supposed to contain nitric acid. I should mention that they were all "stone" acids.

I examined them all qualitatively with the ferrous sulphate test; some were entirely free, others gave a slight colouration, one only gave indication of nitric acid in considerable quantity.

These results somewhat surprised me, for I knew that the complaint would not be made without sufficient reason. The only logical conclusion to come to was that there was something else present besides nitric acid, which was acting injuriously on these complex hydrocarbons.

The one sample which appeared to contain a considerable quantity of nitric acid was placed in a nitrometer and treated in the usual manner. On agitating, the whole surface of the mercury was blackened, and on allowing the instrument to stand a dark brown or brownish black powder collected on the surface of the mercury. This was separated and an attempt made to dissolve it in hydrochloric acid, but it appeared to be insoluble. Nitric acid seemed to have very little action on it. A small quantity was next heated on charcoal when it volatilized with a peculiar bluish flame and characteristic odour, which I at once recognised as due to selenium. Further experiments were made which led me to the conclusion that this powder was selenide of mercury formed by direct union in the nitrometer, but in this I was partly mistaken.

Selenium then and not nitric acid was the objectionable ingredient in the vitriol. The other samples were now agitated in the nitrometer, and all gave varying quantities of this brown powder. In two samples the weight was determined and found to be as follows, from 5 c.c. of acid—

No. 1 = ·052 grammes.
No. 2 = ·067 ,,

On diluting the vitriol with water the selenium was not precipitated, but on passing sulphuretted hydrogen through the diluted acid, a reddish brown precipitate fell down, which I subsequently proved to contain all the arsenic and selenium. On attempting to separate the two sulphides several difficulties presented themselves. In the first place the sulphide of selenium (so-called) does not appear to be of constant composition, variable quantities of free sulphur being thrown down, depending to a great extent on the degree of concentration of the acids. In the second place it is not an easy matter to separate the arsenic and selenium when in the form of sulphides. I tried strong solution of carbonate of ammonia, hoping to dissolve the arsenic, leaving the selenium and lead, and separating these by means of cyanide of potassium.

On carrying out this process with acid purposely contaminated with known quantities of selenium a considerable loss took place.

I next tried to make available the reaction in the nitrometer for quantitative purposes. A known quantity of selenium (vitreous form) was dissolved by heat in pure sulphuric acid. The solution was of a dark green colour, having no resemblance to the disputed samples which were all of a rich brown colour, and on shaking with mercury the whole of the selenium was precipitated in the amorphous form as a red powder. It was also precipitated in the same way by water, so that the artificial sample behaved in a different manner to the original samples.

These differences, however, partially disappeared either on boiling for about two hours or on exposure to light.

On exposing the green coloured selenised acid to sunshine for a day, it became of a reddish brown tint. It was still precipitated by water, and on shaking with mercury the formation of the black powder was noticed to a slight extent.

The boiled sample was also precipitated by water, but I found that the black powder separated by agitation with mercury was not constant in composition, it contained free selenium along with selenide of mercury, for it partially dissolved in hot H_2SO to a greenish coloured solution.

Sulphurous acid was the next reagent tried.

My standard solution of selenium contained ·5 grammes in 200 c.c. of pure sulphuric acid, hence 1 c.c. = ·0025. This solution was made in the cold, and fine determinations were made with varying quantities of selenised acid with the following results:—

	Se. found.	Se. calculated.
No. 1	·0023	·0025
No. 2	·009	·01
No. 3	·009	·01
No. 4	·0024	·0025
No. 5	·0075	·0075

Similar experiments were now made with the same acid solution after boiling with hydrochloric acid, with very similar results.

This process was now tried on two of the original samples, both alone and with the addition of hydrochloric acid. The results of the experiments were as follows:—

Without HCl.

No. 1 .... 20 c.c. gave ·048 grammes.
No. 2 .... 20 c.c. gave ·07 ,,

With HCl.

No. 1 .... 20 c.c. gave ·052 grammes.
No. 2 .... 20 c.c. gave ·076 ,,

Sulphuric acid of a gravity of 1·604 corresponding to chamber strength seems to have very little solvent power for selenium, and, combining this fact with the results of the above experiments, I am inclined to believe that the selenium exists in the chamber acid as selenious acid, and that during the concentration the SeO_2 is reduced to Se by the SO_2 always given off during concentration. This action would not be complete, and hence the vitriol would contain both selenium and selenious acid.

Both the element and its acids seem to have a powerful action on mineral oils, but the precise way in which they act I am at present unable to determine. I am now conducting some experiments to settle this point. I believe, however, that the olefins are chiefly acted upon, compounds being formed analogous to sulphovinic acid. This action would increase the quantity of tar, and on subsequent distillation a portion would be broken up and distil over with the oil, giving it a bad colour.

Acid containing selenium cannot be used by brass wire workers: it blackens the wire; and on boiling it with gas liquor, to make sulphate of ammonia, it turned of a dirty brown to black colour.

The matter is an important one both from the manufacturer's and analyst's point of view, and this I hope will prove a sufficient excuse for my bringing an apparently trivial matter under your notice.

NOTE ON A NEW FORM OF ETHER APPARATUS.

By J. West-Knights, F.I.C., F.C.S.

Read before the Society of Public Analysts on the 14th March, 1883.

Various forms of apparatus have from time to time been devised for the extraction of fat from the natural products in which it occurs, by means of ether or some other volatile solvent, all of which are similar in principle although they differ in form. The best known of these is perhaps the one known as Xoxheth's tube, in which the solvent is passed through the substance to be extracted and received in a flask, from which it is distilled by heat and condensed in a reflux condenser and returned to the tube containing the substance. The form I have used for some time is similar in principle, but is, I think, in many ways to be preferred. In the accompanying sketch A is an ordinary flask connected by means of a cork with the tube of an upright condenser; B is a percolator made by cutting off the bottom of a suitable sized test tube, and blowing a hole, *b*, in the side, about 15 m.m. from the top, and is attached to the condenser tube *inside the flask*. The bottom of the percolator is tied over with a piece of fine cambric, the substance to be extracted is then put in and covered with a piece of filter paper or glass wool, and lastly with a perforated metal disc about 2 m.m. thick. Ether is placed in the flask and boiled, its vapour escapes by the aperture *b* up the condenser tube, and after condensation it falls into the percolator B, percolating through the substance back into the flask, the process being continuous.

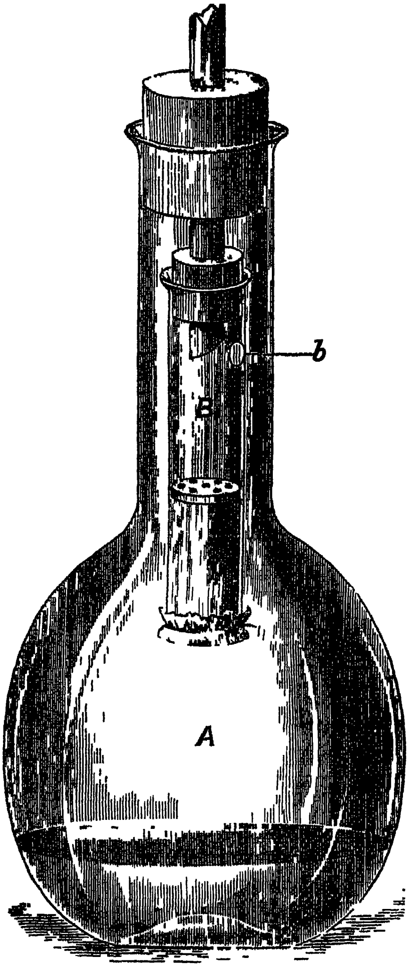
The advantages of this apparatus are: the percolator being inside the flask, is kept hot, *i.e.*, the same temperature as the boiling ether.

The tube when detached being perfectly open at both ends, there is no difficulty in placing and removing the substance; to remove the extracted substance it is merely necessary to take off the cambric and gently push it through from the other end.

And for the same reason, as the substance can be tightly and evenly packed in the tube, there is no fear of the ether passing through in channels.

And lastly, the process is continuous instead of intermittent as in Xoxheth's tube, the result of which is that perfect extraction can be obtained in a shorter time.

I have found this apparatus to work well with coarse fibrous substances, such as oil cakes; finer powders, such as cocoa, do not allow the ether to pass quickly, and a much greater length of time is required.



It is obvious that the apparatus could be used for other purposes than the extraction of fat—*e.g.*, for the extraction of alkaloids from bark by means of alcohol, &c.

In the discussion which ensued

Mr. Hehner said, that it was difficult to make any observations on any new form of ether apparatus, seeing that during the last few years at least 100 different forms had been proposed. He himself was perfectly satisfied with the Xoxheth tube, the advantages of which were, that it worked without any attention being given it, and that a whole milk dish could be put into it.

Mr. Harland said that the apparatus was more applicable to the extraction of substances which required a solvent of high boiling point, such as bisulphide of carbon. The fact of the hot ether coming in contact with the fat took it out in a much less space of time by mere soakage, than it did in the other apparatus referred to.

Mr. Dyer said he had a good deal to do with determining oil in oil cakes, and the apparatus which he used was the old fashioned one employed by Dr. Voelker, which he described, and with which three or four extractions could be done easily in half-an-hour. It was the same apparatus which Dr. Voelker used many years ago.

Mr. Kingzett said he had never used any other form of apparatus than that—it worked perfectly, and a better apparatus for oil cakes could not be desired.

ON THE ADULTERATION OF COCHINEAL.

Cochineal, according to the manner in which the insects are killed, is met with in commerce in two different forms, as dull grains dusted with a white powder, and as shining blackish-brown grains free from dust.

The white, or so-called silvery sort, is well-known to be the subject of various adulterations, being weighted to the extent of ten to twelve per cent. with mineral matters, heavy spar, carbonate and sulphate of lead, chloride of lead, talc, &c., chiefly bodies which have considerable weight in a little bulk. A determination of the weight of the ash left after incinerating a sample of cochineal in a porcelain crucible generally gives the degree of adulteration, whilst a genuine sample leaves scarcely one-half per cent. of ash. On account of the common sophistication of the silvery kind, consumers have gradually come to prefer the black sort, which offered a greater chance of purity, though the appearance of the ware might be inferior. Latterly, however, the latter kind is also adulterated by the addition of manganese, sulphuret of lead, oxide of iron, &c., and weighted to the same extent as the silvery, so that the reason for preferring it has disappeared.

The process of weighting the grain with mineral matter is executed with such skill that it is often difficult even for experienced buyers to detect by the mere appearance, and only a determination of the ash can lead to any definite conclusion.

To moisten the cochineal in the cold with a glutinous liquid, such as gum water, and then to add the mineral matter does not answer, because the water of the adhesive solution dissolves coloring matter out of the cochineal which would redden the white mineral additions and alter the appearance of the sample. On the other hand this method does not allow the adulterant to penetrate into the segment of the cochineal, but is merely smeared over the surface, so that the buyer is not long in doubt.

By means of the following process the weighting is effected in perfection and is doubtless executed in this manner on the large scale. The grain is exposed in a boiler to steam, with the precaution that it is not moistened by condensed water. The grain swells up to a large volume, and out of the chinks between their segments there oozes a red, very adhesive juice, which serves to cement the mineral matter. As soon as the grain ceases to swell it is withdrawn from the atmosphere of steam, the steam is blown off, and the cochineal is placed in a drum ; the mineral matter is added, and the drum is turned till the powder has been completely fixed by the glutinous exudation above mentioned. The grains are then shot out of the drum, and dried in a current of hot air. They return to their former bulk, and hold and partly conceal the weighting material in their folds.

By this procedure white weighting materials are not reddened, and dark ones are little prominent, since the greater part of them are retained and covered by the folds of the dry cochineal, and there is no suspicious dustiness.

Hence, consumers must the more be recommended to buy according to the weight of ash. Certainly this test is useless in case the adulterator has used organic instead of mineral matter as an addition, *e.g.*, flour or starch for the silvery kinds, and asphalt, &c., for the dark kinds. But it must be remembered that in case of such additions the object of weighting is to a great extent sacrificed, as the organic bodies mentioned, if of the same weight as the mineral additions, must have a much greater bulk, and cannot be added in sufficient quantity to make the fraud remunerative.—*Dingler's Polytech. Journal.*

EFFECTS OF OILS ON METALS.

By C. W. Volney.

In the following I give the results of an investigation of the effects of different oils upon metals. The investigation was undertaken in consequence of some preceding papers, bearing upon the subject of the acidity of fatty oils in the columns of the *Oil and Paint Review*. There are, doubtless, several questions involved in this matter, besides the one which I now have endeavoured to answer, and in the course of my labors on this subject I shall try to approach such solutions as may ultimately give practical results. The object is, to prove by actual trials the relative value of different oils, not only as lubricators, but also as protectors of the different metals.

EFFECT ON BRASS.

Strips of sheet brass were covered, each separately with oil. The temperature was 81° F. The strips of metals were weighed; the temperature was kept uniformly at 81° F.; after sixteen (16) days the metal was removed from the oil and carefully washed with alcohol, dried and weighed.

1. *Menhaden Oil.*—Weight of metal: 0·590. The oil had become thick, gummy, and covered with a tough skin After cleaning and drying the metal weighed 0·587; loss, 0·003. The metal itself was covered with a green film; the colour of the oil was unchanged.

2. *Crude Cottonseed Oil.*—Weight of metal when immersed: 0·571. The oil had retained its original consistency. The metal was covered with a green film; the color of the oil was unchanged. Weight of metal after washing and cleaning, 0·572; loss, 0 002.

3. *Lard Oil.*—Weight of metal when immersed, 0·572; the oil showed no change of consistency or color; there was only a slight tinge of green on the metal, which weighed after washing and cleaning, 0·5715; loss, not quite 0 001.

4. *Olive Oil.*—Weight of metal before immersion, 0·794. The oil was green from dissolved oleate; the metal was thickly covered with green film. Weight of metal after washing and cleaning, 0·790; loss, 0·004.

5. *Neatsfoot Oil.*—Weight of metal before immersion, 0·791; no change in color or consistency of oil, but a green residue or precipitate had collected on the bottom of the

glass; the metal was covered with green oleate. Weight of metal after washing and cleaning, 0·787; loss, 0·004.

6. *Crude Petroleum from Scio.*—Weight of metal before immersion, 0·717. No change was observed in consistency or color of the oil, and there was no change in the appearance or color of the metal. Weight of metal after washing and cleaning, 0·717; loss, none.

The foregoing trials express in themselves the fact that the mineral oils form the best protectors for brass. The figures obtained by expressing the loss caused by the oils upon the metal, give also the relative value of the oils in this respect. Reduced, the following table is obtained, which may be considered as an indicator of the dissolving or corroding effect of these oils upon brass:

Menhaden Oil	·511
Neatsfoot Oil	·505
Olive Oil	·504
Crude Cottonseed Oil	·348
Lard Oil	·131
Crude Petroleum from Scio	·000

These figures may express the chemical effect of these oils upon brass, and thus give values for the estimation of these oils as protectors of metals: to form estimates of their values as lubricators, the above obtained factors will doubtless prove valuable, but the mechanical action in friction will have also to be considered.

These figures also express merely results obtained with the oils under investigation, as the acidity of the vegetable and animal oils differ. Probably the results of their effects upon metals will differ; but in general it may be stated that these oils in course of time will invariably show acidity, and in this respect only mineral oils are excepted.—*Oil and Paint Review.*

POISONOUS COLORS IN GERMANY.

The following decree, concerning the prohibition of poisonous colors for the coloring of certain alimentary substances and articles of food, comes into operation in Germany, on 1st April instant.

1. The use of poisonous colors for the manufacture of food-products or articles of food intended for sale is prohibited. Those which contain the following materials or compositions are considered as poisonous colors within the meaning of this enactment: antimony (oxide of antimony), arsenic, barium (except sulphate of baryta), lead, chromium (except pure chromic oxide), cadmium, copper, mercury (excepting cinnabar), zinc, tin, gamboge, picric acid.

2. The preserving and packing of food-stuffs or food-products intended for sale in wrappers colored with the above-cited poisonous colours, or in barrels in which the poisonous color is so employed that the poisonous coloring matter can pass into the contents of the barrel, is prohibited.

3. The employment of the poisonous colors enumerated in Art. 1 is prohibited for the manufacture of playthings, with the exception of varnish and oil-paints made of zinc-white and chrome-yellow (chromate of lead).

4. The use of colors prepared with arsenic for the manufacture of paper-hangings, as well as that of pigments containing copper prepared with arsenic, and of matters containing similar colors for the manufacture of materials of dress, is prohibited.

5. The putting on sale, and the sale, wholesale or retail, of food-stuffs and food-products preserved or packed contrary to the regulations of Articles 1 and 2, as well as playthings, paper-hangings, and dress-materials manufactured in contravention of the directions in Articles 3 and 4, are prohibited.

REVIEW.

Synopsis of Chemistry, Inorganic and Organic: to assist Students Preparing for Examinations.

By T. W. Drinkwater, F.C.S.

Edinburgh: Young J. Pentland. London: Hamilton, Adams & Co.

The author states in the preface to this book, he hopes it will "take the place of the Note-Book in re-calling the principal facts of the science in the unsettled and troubled times which precede examination." At first sight we should therefore feel justified in condemning it as a *cram book*, but after a thorough perusal of its contents—which have been carefully condensed—this idea is at once changed: not only are all the more common reactions with their formulæ given, and a large number of special reactions in tables, but also the occurrence, properties and preparation of chemical substances; requiring a large amount of work in their collection.

The *cramming student*, and he is a member of a large community, would indeed have a task before him to get up, or select from, the contents of this work the *pass* reactions and properties of the elements and compounds, when they are set before him in hundreds; for this selection would require some experience in chemical science.

LAW REPORTS.

A label does not protect where the admixture is so large as to be fraudulent. Able conduct of a case by an Inspector:—

Messrs. Crapon, Brine & Co., grocers, of 63, Old Kent Road, were summoned before Wyndham Slade, Esq., at the Southwark Police Court, on the 7th of March, by Mr. John Edwards, the Inspector appointed by the Vestry of St. George-the-Martyr, for selling coffee not of the nature, substance, and quality demanded by such purchaser.

C. Niblett said, on the 8th day of February he was directed to purchase a ¼-lb. of sixteenpenny coffee at the defendant's shop; he was served and paid fourpence for it. His attention was not called to any notice. He delivered up the coffee to the Inspector on the premises.

Mr. John Edwards, Inspector, stated that he received the parcel referred to from the last witness in the shop of defendants, and said to the shopman, "This purchase is made for the purpose of analysis, by Dr. Muter, the Public Analyst." He proceeded to divide the parcel into three parts when his attention was called by the shopman to a notice on the wrapper: "This is sold as a mixture of coffee and chicory." He delivered a portion to the Analyst and received a certificate from him, showing that the article contained coffee 25 parts, chicory 75 parts. The magistrate said he considered at first sight the notice met with the requirements of the Act, but the Inspector submitted that in this case the notice was no protection to the seller, inasmuch as the Sec 8 which protects, also makes the condition that there should be no intention to fraudulently conceal its inferior quality. He contended that coffee being asked for, and the price of coffee paid for the article, 75 per cent. of chicory was a fraudulent mixture which was not protected by the Act. He referred his Worship to the case of Liddiard *v.* Reece, reported in *The Analyst*, of which he produced a copy. The Magistrate, with the Chief Clerk, adjourned from the court for a time to refer to the Law Reports, but could not find the case mentioned, and stated that in the case of Sandys *v.* Small the notice was held to be sufficient. Mr. Edwards remarked that that case was one of a Publican, who had a notice placed in a conspicuous part of his bar, where customers on entering the house could see it, and no attempt at fraud was alleged, and here asked his Worship to adjourn the case for one week for further consideration.

On Wednesday, the 14th of March, the adjourned case was proceeded with, when his Worship referred to the " Justice of the Peace " reports on Liddiard *v.* Reece, the judgment of Justices Lush and Manisty, and recalled Niblett, the first witness:—

Q.—What did you ask for? *A.*—A $\frac{1}{4}$-lb. of sixteenpenny coffee.

Q.—Was anything said to you? *A.*—Nothing whatever.

In answer to the Magistrate, Mr. Edwards said that was his case, and asked his Worship to inflict a substantial penalty. The Magistrate said that he considered that when a person asked for coffee, to be supplied with 75 per cent. of chicory was most fraudulent, and fined the defendants £10 and 12s. 6d. costs.

Small fine for 80 per cent. of Chicory—

At the Birkenhead Police Court, Mr. John Stanway, grocer, Watson Street, was summoned for selling coffee which was found to be adulterated with 80 per cent. of chicory. Mr. Solby, deputy town clerk, prosecuted; and Mr. Thompson defended. Mr. Smith, chief inspector of nuisances, stated that on the 20th ult. he went to the defendant's shop and asked for three-quarters of a pound of the best coffee. Mrs. Stanway said she only kept one kind of coffee, at 1s. 4d. per pound. He was supplied with the quantity he had asked for, and had it submitted to analysis, when it was found to be adulterated with about 80 per cent. of chicory, which was an unusually large proportion. For the defence, Mr. Thompson stated that Mr. Smith received value for his money, and as he did not ask for pure coffee, but for the best coffee, Mrs. Stanway did not pretend that the coffee was without chicory, and, in her evidence, stated that she sold the coffee exactly as it was supplied to her by Messrs. Timmis, wholesale merchants, Birkenhead. Mr. Preston said the case was no doubt one in which the article asked for was not supplied, and he imposed a penalty of 10s. and costs.

RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

No. 1882	Name of Patentee.	Title of Patent.	Price
84	W. R. Lake	Dynamo Electric Machines	6d.
2419	W. H. Akester	Electric Arc Lamps	6d.
2491	C. W. Vincent	Secondary Batteries	2d.
2493	J. W. Leather	Manufacturer of Hydrochloric Acids	2d.
2558	J. S. Williams	Generation, Storage, &c., of Electricity	1/0
2643	H. Woodward	Secondary Batteries	2d.
2803	F. L. Willard	Dynamo Electric Machines	6d.
2876	H. Gaskell & F. Hurter	Manufacture of Carbonate of Soda	6d.
2913	S. H. Emmens	Secondary Batteries	6d.
2914	S. H. Emmens	Electric Lamps	6d.
2917	T. Parker & P. B. Elwell	Dynamo Electric Machines	4d.
2918	S. Pitt	Obtaining Ferrocyanide of Iron, &c., from Coal Gas Manufacture	4d.
2932	H. J. Haddan	Manufacture of Artificial Manure	4d.
2913	H. Aron	Primary and Secondary Batteries	4d.
2962	M. Volk	Incandescent Electric Light Lamps	2d.
2981	J. Duke	Purification of Gas, and Manufacture of a Fertilizing Compound	4d.
3002	P. Jenson	Dynamo Electric Machines	8d.
3006	H. Von Roden	Preserving Milk, &c.	2d.
3010	W. Debenham	Electric Lamps	4d.
3044	J. Erskine	Production of Derivatives of Alpho Oxhydro Chinoline, &c.	4d.
3036	W. E. Ayrton & J. Parry	Dynamo Electric Machines	6d.
3072	G. W. Von Nawrocki	Manufacture of Hyposulphite of Soda	2d.
3079	J. H. Johnson	Electric Lamps	2d.

No. 1882	Name of Patentee.	Title of Patent.	Price
3107	C. H. Cathcart	Secondary Batteries	4d.
3108	H. J. Haddan	Ditto	2/4
3125	C. Wigg	Manufacture of Carbonate of Soda	6d.
3150	R. Werdermann	Dynamo Electric Machines	6d.
3159	G. W. Von Nawrocki	Extracting Grease from Bones	6d.
3161	A. R. Leask	Incandescent Lamps	2d.
3172	J. Imray	Voltaic Batteries	6d.
3179	E. T. Hughes	Manufacture of Sugar	2d.
3181	A. Lovy	Dynamo Electric Machines	2d.
3186	W. Weldon	Recovery of Sulphur from Alkali Waste	4d.
3216	J. Erskine	Production of Ortho-nitro-meta-methylbenzaldehyde	4d.
3218	J. Erskine	Production of Cinnamic Acid, &c.	4d.
3221	R. H. Woodley & H. F. Joel	Secondary Batteries	2d.
3244	Y. J. Handford	Incandescent Electric Lamps	2d.
3255	J. H. Gardiner	Ditto	6d.
3245	J. & R. Dempster	Separating Tar from Ammoniacal Liquor	6d.
3279	J. S. Beeman	Electric Lamps	4d.
3303	F. W. Durham	Secondary Voltaic Batteries	4d.
3305	J. P. Rickman and J. B. Thompson	Manufacture of Ammonia	6d.
3342	F. Wirth	Production of Alkali Salts from Sulpho Acids	4d.
3343	F. Wirth	Manufacture of Beta-naphthylamine Sulpho Acid	2d.
3385	L. A. Groth	Electric Arc Lamp	6d.
3418	S. Z. De Ferranti and A. Thompson	Electric Arc Lamps	6d.
3419	S. Z. De Ferranti and A. Thompson	Dynamo Electric Machines	6d.
3455	J. S. Beeman	Dynamo Electric Machinery	6d.
3464	J. H. Johnson	Secondary Batteries	2d.
3480	J. H. Johnson	Unhairing Hides or Skins	2d.
3508	A. Clark	Electric Lamps	6d.
3520	A. L. Lineff	Electric Arc Lamps	6d.
3528	C. E. Buell	Secondary Batteries	8d.
3532	G. L. Winch	Secondary Batteries	6d.
3534	O. W. Hill	Dynamo Electric Machines	6d.
3570	F. M. Newton	Electric Arc Lamps	6d.
3575	J. G. Lorrain	Electric Lamps	6d.
3577	A. J. Boult	Manufacture of Caustic Soda and Caustic Potash	6d.
3592	F. J. Bolton	Secondary Batteries	10d.
3608	C. F. Claus	Obtaining Sulphur from Sulphide of Hydrogen	4d.
3636	T. S. Kirkpatrick	Separating Metallic Ores from their Gangue	2d.
3643	A. Feldmann	Manufacture of Ammonia	6d.
3655	O. G. Pritchard	Electric Lamps	2d.
3685	W. R. Lake	Dynamo Electric Machines	6d.
3700	E. G. Brewer	Secondary Batteries	6d.
3714	S. Pitt	Manufacture of Sulphurous Anhydride	6d.
3721	F. Wirth	Manufacture of Sulpho Acids and Colouring Matters therefrom	4d.
4992	F. C. Glaser	Manufacture of Fatty Matter from Wool Fat	4d.

BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Practicien; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York, The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review.

THE ANALYST.

MAY, 1883.

SOCIETY OF PUBLIC ANALYSTS.

A General Meeting of this Society was held at Burlington House, on Wednesday, the 18th April.

In the absence of the President, the chair was taken by Dr. Dupré, F.R.S.

The ballot papers having been opened, the following gentlemen were found to be duly elected as Members: Dr. Davenport Hill, Public Analyst, Massachusetts, and Mr. W. Fox, Analytical Chemist, London.

The following were proposed for election as Members: H. B. Turner, Analytical Chemist, Sanitary Clerk to the City of London, and B. A. Burrell, Public Analyst for Cork, and will be balloted for at the next meeting; also Mr. Bodmer, Assistant to Dr. Stevenson, as Associate.

The following papers were read and discussed:

"Some Remarks on the Permanganate Process in Water Analysis," by Bernard Dyer, F.C.S. F.I.C.

"Estimation of Hardness without Soap," by Otto Hehner, F.I.C.

The next Meeting of the Society will be held at Burlington House, on Wednesday, 30th May.

SOME REMARKS ON THE PERMANGANATE PROCESS IN WATER ANALYSIS.

By Bernard Dyer, F.C.S., F.I.C.

Read before the Society of Public Analysts, on April 18th, 1883.

The experiments about to be mentioned were made in my laboratory some years ago, soon after Dr. Tidy read before the Chemical Society a paper in which he proposed certain standards of oxygen absorbed from permanganate solution for the purpose of classifying samples of potable water. In the same paper the author condemned the free and albuminoid ammonia process of Mr. Wanklyn, as being not only uncertain and unreliable, but less delicate in its indications than the permanganate process; and, shortly afterwards, Dr. Frankland, in his book on water analysis, expressed his opinion that the permanganate process was probably the best substitute for the combustion process. The ease and rapidity with which the permanganate process could be carried out led some analysts to adopt it at once, in lieu of the previously almost universal process of Mr. Wanklyn, and analyses of waters were published in the *Chemical News* and elsewhere, without other figures relating directly to their organic constituents than those of oxygen absorbed. The method, as described at the Chemical Society, although an old one, was invested with novelty in as far as its description was accompanied by the proposal of standards for judging the waters tested by it, and this addition rendered its adoption, as a supposed simple and ready test for organic purity, particularly tempting to medical men and other pseudo-chemists, as well as to many analysts, who had hitherto been in the habit of giving reports on the results of the Wanklyn process, which involves more manipulative skill.

The experiments I now quote were made with a view to showing that the free and albuminoid ammonia process afforded a more delicate and reliable means of judging a water than does the permanganate process, if the methods were to be regarded as alternative, and only one of them to be employed. The appointment, however, of a "Water Committee" of the "Society of Public Analysts," and the issue of the "full instructions" for water analyses that followed, did much to bring about a generally much fuller analysis of waters than the majority of our analysts had been in the habit of making, leaving the permanganate process to remain as one only of many items in the table of results, and I did not publish these experiments.

The results of experience show us more and more the futility of trusting to anything short of a complete examination of waters, and recent communications to our Society demonstrate the fact that even the results of a complete examination often have their meaning wholly changed by local circumstances. In the recent paper of Dr. Dupré and Mr. Hehner, and also in that of Dr. Ashby and Mr. Hehner, it was shown that the free and albuminoid ammonia test in certain cases might, owing to the rapidity with which nitrification takes place, entirely break down. Much more confidence on the other hand, in the results of the permanganate process, was expressed during the discussion which followed one of the papers, which has led me—in continuance of that discussion—to look up the trials I have referred to.

I regret that the permanganate experiments, having been made before the recommendations of our Water Committee, were made at the ordinary temperature of the laboratory, which, in autumn, might be from 50° to 60° Fahr., the precautions, otherwise, being those enumerated in Dr. Tidy's description of the method.

URINE AND DISTILLED WATER.

Urine (Parts per 1,000).	Oxygen Consumed (Grains per gallon).		Ammonia (Grains per gallon).	
	One hour.	Three hours.	Free.	Albuminoid.
·05	·003	·004	·007	·003
·10	·005	·005	·015	·006
·25	·011	·019	·028	·021
·50	·021	·032	·059	·045
1·00	·041	·052	·121	·105

URINE AND NEW RIVER WATER.

Urine (Parts per 1,000).	Oxygen Absorbed (Grams per gallon).		Ammonia (Grains per gallon).	
	One hour.	Three hours.	Free.	Albuminoid.
·00	·016	·022	·001	·002
·05	·019	·028	·006	·004
·10	·020	·030	·010	·006
·25	·026	·037	·021	·012
·50	·040	·047	·044	·025
1·00	·059	·071	·091	·054

(CLEAR) SEWAGE AND NEW RIVER WATER.

SEWAGE (Parts per 1,000).	OXYGEN ABSORBED (Grains per gallon).		AMMONIA (Grains per Gallon).	
	One hour.	Three hours.	Free.	Albuminoid.
none	·017	·035	·000	·001
2·5	·027	·039	·005	·001
5·0	·029	·041	·010	·003
10·0	·032	·044	·020	·005
20·0	·039	·048	·038	·011
50·0	·047	·053	·092	·025
100·0	—	·074	—	—

The classifications which Dr. Tidy suggested by way of standards were as follows:—

CLASS I. *Waters of Great Organic Purity.*—All waters in which the oxygen absorbed does not exceed ·035 grain per gallon.

CLASS II. *Waters of Medium Purity.*—Waters in which the oxygen absorbed ranges from ·035 to ·100 grain per gallon.

CLASS III. *Waters of Doubtful Purity.*—Waters in which the oxygen absorbed ranges from ·100 grain to ·150 grain per gallon.

CLASS IV. *Impure Waters.*—Waters in which the oxygen absorbed exceeds ·150 grain per gallon.

Looking at the foregoing results it will be seen that distilled water containing five parts of urine in 10,000, or New River water containing one part of urine in 10,000, would thus be classed as water of *Great Organic Purity.* New River water containing one part per 1,000 of urine, or as much as 10 per cent. of raw sewage, would be classed as of *Medium Purity.* On the other hand the free and albuminoid ammonia results cast more than grave suspicion on distilled water, or even on New River water contaminated with one part of urine in 10,000, and on New River water containing from half per cent. to one per cent. of sewage; while New River water containing one part of urine in 4,000, or two per cent. of sewage, was utterly condemned by the free and albuminoid ammonia process.

The analyses published month by month in the ANALYST of the same water supplies show how great are the periodical variations in oxygen absorbed by water from the same sources, but, at the present moment, as being more strictly comparable for the present purpose, I will refer to the results of the oxygen absorbed by New River water during one year, as shown in the analyses given by Dr. Tidy in the paper already quoted. The proportion of oxygen absorbed by New River water in 1878 varied from ·016 grain per gallon to ·058 grain per gallon. This difference would allow—judged by the oxygen test alone—an addition of one part of urine per 2,000 of water, or an addition of five per cent. of raw sewage, to pass unsuspected, and without infringing the limits of natural variation in the water itself. Presuming the absence of rapid nitrification, a very far less quantity of pollution would, as already indicated, be at once shown up by the increased free and albuminoid ammonia. It was at the time pointed out that the natural variation in oxygen absorbed was in the case of this, and the Thames water, unaccompanied by a similar variation in the ammonia results, and that the albuminoid ammonia varied but slightly, while the oxygen absorbed varied *pari passu* with the organic carbon and nitrogen shown in Dr. Frankland's analyses. I incline to the opinion that the main cause of this fact is that the greater part of the organic matter in Thames and New River water is of vegetable origin, and affects the free and albuminoid ammonia tests but slightly, these tests being far more delicate as indicators of animal than of vegetable impurity.

It has been very strongly urged that the more ready oxidisability of animal matter enables us to form some discrimination between it and vegetable matter, by making two tests, as in the foregoing experiments, viz.: by allowing the permanganate to act respectively for one hour and three hours.] This method has been, as most of us believe, improved upon still further by altering the times of action respectively to fifteen minutes and four hours, according to the suggestions first published, I believe, in the instructions of the Water Committee of the Society of Public Analysts. But it is not difficult to see—in fact it is obvious—that the deductions drawn from the comparison of such results must often be rendered almost worthless in an absolute sense, by the proportion of vegetable to animal matter present. Where the organic matter is mainly of animal origin, doubtless the high proportion of the oxygen absorbed in the shorter period to that absorbed in the longer period will be boldly shown. But the same quantity of animal matter, together with a larger proportion of vegetable matter, will not reveal itself with like delicacy. In fact, as in the case of the organic carbon and nitrogen, the damnatory ratio of the two in the animal matter may be hopelessly swamped in the innocent ratio of a larger quantity of vegetable matter.

No doubt general standards of all kinds in water analysis are fallacious, and the necessity of circumspection and carefully balanced judgment in framing our reports on waters becomes more and more apparent as additional experience is gathered. I do not for a moment suggest the abandonment of a factor which is of such value as the permanganate process occasionally is as a confirmatory or comparative test, any more than the authors of the recent interesting papers read before the Society would recommend the abandonment of the free and albuminoid ammonia process, because nitrification may sometimes render its results nugatory. But in the absence of very exceptional circumstances, the permanganate process affords us, I venture to believe, far less information on the subject of water pollution than do the other items in our analyses, and in an absolute sense it is in the majority of cases useless. Relatively it may possess value—occasionally considerable value—and is, therefore, not to be neglected; but except for purposes of comparison it appears to be meaningless, and is at the best, as far as I am able to judge, to be looked upon with diffidence.

Dr. Dupré said he was very glad Mr. Dyer had at last consented to give them a paper, and he hoped that other members of the Society would take courage from that and bring their experience forward. The chief value of the Society was lost if the members did not bring their facts before it—every fact might be of value. No member should think that any fact was too insignificant to be brought forward.

Mr. Hehner pointed out that as in one case there were five parts of urine in 100,000. Urine contained about two per cent. of urea, which furnished about half its weight of ammonia, and hence five parts of urine in 100,000 should give ·035 gr. of ammonia per gallon. Mr. Dyer, however, only found ·007, and he should like to know where the rest had gone to. Another point he wished to refer to was that he was firmly convinced the oxidizable part in sewage was not organised and dead, and it was the non-oxidizable part which was dangerous.

Dr. Dupré in answer to Mr. Hehner said, first—that if perfectly fresh urine were taken no free ammonia and no albuminoid ammonia would be obtained, but after standing awhile much ammonia was obtained by distillation; and, secondly—that they could not judge anything as to the amount of urine added by the ammonia obtained. With reference to Mr. Dyer's paper he (Dr. Dupré) had great faith in the permanganate test; there was no process like it to distinguish a deep from a shallow well water, or to distinguish whether a deep well water was contaminated with surface drainage or sewage. As soon as there was a slight amount of surface contamination into the well evidence of it was obtained by the increased amount of oxygen absorbed. In several cases a water had been sent to him which yielded a very considerable amount of ammonia, but tested by the oxygen it absorbed he felt sure at once it could not be a polluted water. He did not consider urine one of the best substances to experiment on water with. It would seem to him from the results that Mr. Dyer was a very good worker with the ammonia process, but not quite so good with the oxygen process. In the case of ammonia and albuminoid ammonia the results were very fairly proportionate; not so in the oxygen series. One process had worked well and the other not so well.

In the case of the sewage which had been added to the waters it must have been very dilute sewage. He had made a great many experiments, and he found that with anything like five per cent. the oxygen absorbed came to ·2 or ·3, which was nearly ten times the amount Mr. Dyer had found with twenty parts in 1,000. Therefore, he could not help thinking that the sewage must have been very much diluted.

He did not wish to imply that there was any marked superiority of the one over the other, but what he believed was that taking the two processes together they got exceedingly valuable indications, and carefully applying both they got a good idea of whether the contamination was animal or vegetable, although not by either separately.

They had no means of getting at the absolute amount of organic matter present in a water. Even Frankland's process did not give them that.

Dr. Muter said that for many years he had been a supporter of the permanganate process. Any water that would stand it was a safe water to drink or rather it was better not to drink any water that would run away with the permanganate. As a sort of empirical test it was very good indeed, and one he had always been in favour of. If he were going on a journey he would prefer to take a bottle of permanganate in his pocket to judge a water by rather than anything else.

After all that had been said against it he thought there was no more complete scheme of water analysis before the public than that issued by the Society.

ESTIMATION OF HARDNESS WITHOUT SOAP SOLUTION.

By Otto Hehner, F.I.C.

Read before the Society of Public Analysts, 18th April, 1888.

Of all methods of which analysts are in the habit of availing themselves in judging of the quality and composition of drinking water, that for the estimation of the hardness by means of soap solution is by far the most imperfect. It is objectionable for a variety of reasons.

First.—It does not measure the soap-destroying power of any water, the hardness of which exceeds 16° ; washerwomen not being in the habit of diluting the water they have to use by adding distilled water until the total hardness is less than 16°.

Secondly.—It does not, in any case, measure the lime with any degree of accuracy, and in many instances will under-indicate its amount very considerably.

Thirdly.—It altogether fails in the presence of anything like considerable amounts of magnesia.

Fourthly.—It lacks the most essential character indispensable to any workable volumetric method, viz., that one and the same measure of the standard solution, should, within fairly elastic limits, indicate always the same amount of the substance to be measured, it being notorious (see Clark's several tables) that the indications fluctuate for equal measures by nearly 30 per cent.

Fifthly.—The directions given by the various writers on the subject as to the indications given by the solutions not only disagree, but are absolutely contradictory ; and

Lastly. –The soap solution, even if made with much alcohol, does not keep.

Almost any one of these reasons by itself would have been sufficient to induce analysts to abandon any other volumetric method suffering from like deformities, but the " soap test " has survived in spite of them all. It follows, either that the method is so indispensable that it *must* be used although defective, or that its indications are accepted as merely approximate and devoid of any claims to accuracy. It is easy to show that not the former but the latter of these alternatives furnishes the true explanation. Thus, if one reads that one well-known author directs for the preparation of the *Standard* soap solution 10 grammes of Castile soap to be dissolved in 1 litre of alcohol and water, without any subsequent standardising being requisite ; and for that of the *Standard* calcium solution (the use of which is optional), 1·11 grammes of calcium chloride to be dissolved to a similar bulk ; it is evident that the faith of the eminent chemist alluded to, in either of his *Standards* (save the mark !), must be remarkably small. I venture to say that not one sample of Castile soap of the precisely requisite composition can be found in the market, and I have yet to see the pure, anhydrous and non-alkaline calcium chloride fit for making a stardard solution. Besides, not 10, but 9·82 grammes of Castile soap, containing 60 per cent. of olive oil would be theoretically required to give a solution of the proper strength.

The reaction between soap solution and calcium and magnesium salts has been largely misunderstood, and a great deal of misapprehension and difficulty has been produced by the incomplete knowledge of that reaction. If sodium oleate, and calcium and magnesium salts in their mutual action produced nothing else but calcium and magnesium oleates and neutral sodium compounds, there would be no reason whatever why waters of *any* hardness should not be correctly tested by the soap method, or why the presence of magnesia should create the slightest difficulty.

A very simple and striking experiment however, shows that the reaction instead of being a mere double decomposition is a much more intricate one. If a solution of soap, which must be perfectly neutral to phenolphthaleine, be poured into distilled water containing some of that indicator, the deep violet colour produced conclusively proves the liberation of a large amount of free alkali or of a basic oleate. This reaction justifies the statement which is commonly made in explanation of the detergent action of soap, but no colouring matter illustrates the fact so well as does phenolphthaleine, turmeric being unsuited, as it gives an alkaline reaction even with soap neutral to the phthaleine. If the neutral soap solution is poured instead into distilled water into ordinary drinking water plus phenolphthaleine, the alkaline indication becomes quite marked *before* there is an excess of soap; that is to say, before a lather can be produced. The natural and inevitable consequence of the presence of the free alkali is the neutralization of free and half combined carbonic acid, the precipitation of part of the calcium carbonate, and, in the presence of a sufficient amount of magnesium salts, the separation of magnesium hydrate.

In waters with an excess of free carbonic acid the separation of calcium carbonate could not take place; but, in most very hard waters, calcium oleate and calcium carbonate would be precipitated concurrently and the hardness would be under-rated. Hence the necessity of diluting hard water down to a very low degree.

In the presence of magnesium salts, the lather, as is well known, becomes tenaceous and devoid of lustre. According to the explanation given above, free flocculent magnesium hydrate would be the cause of this appearance.

When all the lime is precipitated, a lather is obtained, but after a while this disappears, and a further quantity of soap solution is wanted, corresponding roughly with the amount of magnesia present, to produce a permanent bright lather. I can offer no other explanation of this phenomenon but that the precipitated magnesium hydrate acts upon the soap and gradually is finally converted into the oleate. Indeed, magnesia suspended in distilled water does consume soap solution.

My explanation thus embraces the three puzzling points in the testing of the hardness by soap, viz., the impossibility of accurately titrating *hard* waters; the dirty appearance of the lather in magnesian waters; and the stop at which one arrives when all the lime is precipitated, the magnesia gradually coming into action.

I think I have said enough to remove Clark's method of hardness estimation out of the list of tolerable volumetric methods. Its indications cannot be uniform, but are dependent upon the circumstances of each individual case.

Digressing somewhat from my subject, I should like to point out, that, quite analogous with the misconception of the soap reaction is Clark's idea of softening water by lime. He directs to estimate the temporary hardness and to add an amount of caustic lime equal to that present as carbonate. It is palpably evident that the temporary hardness has nothing whatever to do with the amount of lime to be added; this depending *solely* upon the quantity of free carbonic acid, which is *not*, in any way, regulated by the proportion of temporary hardness.

Now it must be acknowledged that it is desirable to uphold the distinction of calcium and magnesium salts as "temporary" and "permanent," a simple gravimetric estimation of these two bases not giving sufficient information as to the character of the water.

The method which I am about to propose is not new in principle; it is an extension of Mohr's process of titrating alkaline carbonates in water by means of standard acid.

I prepare a standard acid by diluting 20 c.c. of normal sulphuric acid (49H_2SO_4 per litre), to 1,000 c.c., and a solution of 1·06 of pure, freshly ignited sodium carbonate in a litre of distilled water. 1 c.c. of the acid is capable of neutralizing ·001 gramme of

$CaCO_3$, whilst 1 c.c. of the sodium carbonate solution precipitates a like amount of $CaCO_3$ from any soluble lime salt, or an equivalent weight of magnesia. Equal volumes of the two solutions neutralize each other.

100 c.c. of any water to be tested are tinted with phenacetoline, methylorange or cochineal solution, heated nearly to boiling, and the standard acid is added to neutrality. Each c.c. used indicates one degree of *temporary hardness*, calculated for 100,000 parts. So far, Mohr's method.

To another 100 c.c. of the water a measured quantity of the sodium carbonate solution is added, a good deal more than enough to decompose the whole of the soluble (permanent) salts of lime and magnesia. Generally an amount in c.c. equal to about the proportion of total solids per 100,000 is amply sufficient. The mixed solutions are then evaporated in a platinum basin to dryness. The residue is taken up with a little recently boiled distilled water, the solution filtered through a *very little* filter, the residue washed three or four times with very small amounts of water, and the alkalinity of the clear solution titrated hot by means of the standard acid. The alkali added, minus the acid used, indicates the *permanent hardness*, calculated as $CaCO_3$.

The evaporation must take place in *platinum*, glass yielding even during a comparatively short time so considerable traces of alkali to the hot solution that the permanent hardness is much under-estimated. It is well to evaporate to dryness, in order to render the magnesia, which at first separates as voluminous flocks, granular, compact and readily washable. Generally, at most 150 to 200 c.c. have to be evaporated, and this, of course, takes very little time.

Of the three indicators enumerated I prefer phenacetoline. It is red in alkaline and yellow in acid solutions, methylorange being yellow in presence of alkali and red with acid. The change is sharpest with phenacetoline, but slightly less so with methylorange, and more gradual with cochineal. All three indicators are, contrary to the statements generally made in respect to them, somewhat sensitive to carbonic acid. For if a solution of sodium carbonate, tinted with one of them, be neutralised as accurately as possible with acid, and the solution then heated just to the boiling point, an alkaline reaction will again manifest itself, and a further small volume of acid will be required to render the liquid permanently neutral. Such effect of carbonic acid may not be noticeable when working with standard solutions of ordinary strength, but it must not be neglected when milligrammes and tenths of milligrammes are to be measured.

The following figures will show that, when working as described, the two solutions, Na_2CO_3 and H_2SO_4, very accurately neutralise each other:—

PHENACETOLINE.			METHYLORANGE.			COCHINEAL.	
c.c. Acid.	c.c. Alkali.		c.c. Acid.	c.c. Alkali.		c.c. Acid.	c.c. Alkali.
18·2	18·0	......	23·	22·5	......	22·2	21·7
24·3	24·3	......	15·8	15·3	......	—	—
16·8	16·6	......	25·0	24·8	......	—	—

That the process (Mohr's) of estimating alkaline carbonates in water by titration with acid is capable of giving very fair results, is generally acknowledged. I have, however, deemed it advisable to carry out some test experiments in this direction. I also append a number of analyses, in which both the temporary and the permanent hardness were titrated alkalimetrically, the amounts of lime and magnesia being likewise determined by precipitation.

Solution of Calcium Carbonate.—Gravimetrically, 28·0 $CaCO_3$ per 100,000. Volumetrically, 27·5.

Magnesium Carbonate Solution.—Contained 13·2 parts of MgO, corresponding to 33·0 of $CaCO_3$. 100 c.c. used 33·5 c.c. acid.

Calcium Chloride.—47·60 CaO = 85·0 $CaCO_3$. Temporary hardness, none; permanent, 84·8.

Magnesium Sulphate.—8·66 MgO, corresponding to 21·7 of $CaCO_3$. No temporary hardness; permanent, 22·3.

Solution containing Magnesium Chloride and Calcium Sulphate.—CaO 37·72 = 67·4 $CaCO_3$. MgO 7·23 = 18·1 $CaCO_3$. Calculated hardness, 85·5. No alkalinity. Permanent hardness, 85·2.

Water, containing 11·88 CaO = 21·2 $CaCO_3$, and ·47 MgO = 1·17 $CaCO_3$. Calculated hardness, 22·4. Alkalinity, 18·7. Permanent hardness, 3·2. Total hardness titrated, 21·9.

Water, containing 21·92 CaO = 39·1 $CaCO_3$, and ·73 MgO = 1·7 $CaCO_3$. Calculated hardness, 40·8. Temporary hardness (alkalinity), 23·3. Permanent, 17·4. Total found, 40·7.

Water, with 8·78 CaO = 15·7 $CaCO_3$, and ·69 MgO = 1·7 $CaCO_3$. Calculated hardness, 17·4. Used 14·2 c.c. for temporary and 3·8 c.c. for permanent hardness. Total found, 18·0.

Water, with 11·48 CaO = 20·5 $CaCO_3$, and 4·01 MgO = 10·0 $CaCO_3$. Calculated hardness, 30·5. Used 15·7 c.c. of acid for temporary hardness; permanent, 13·6. Total found, 29·3.

These test experiments, I trust, will be held to supply a sufficient amount of proof of the accuracy of the method proposed; they also show that it is applicable equally to lime and magnesium waters.

I sincerely hope that the alkalimetric estimation of both descriptions of hardness will speedily supersede the use of soap solution, which has no other recommendation than its comparative antiquity.

ON CONDENSED MARE'S MILK.

By Dr. P. Vieth, F.C.S.

Whilst cow's milk has been condensed on a large scale since several decennaries, and this branch of industry has spread over nearly all the countries of Europe, nothing was heard of condensed mare's milk until a very short time ago. If some mare's milk has been condensed at all previous to the year 1882, it certainly was done as a mere experiment and not as a matter of business, with the aim to augment the number of foods specially destined for nourishing infants and invalids by a new preparation.

It was only in the last year that this subject was taken up by an English company, which established a manufactory of condensed mare's milk at Samara, in the steppes of Southern Russia. Condensing was executed for several months in the last autumn, until with the beginning of the winter the milk supply stopped. I learn that mare's milk, condensed during that time, is used daily in a children's hospital in St. Petersburgh, with very satisfactory results.

But it is not my business to speak about the effect of the preparation, especially as that would be premature, experiments with the milk having been carried on in one place for a proportionately short time only. I merely want to publish the results of the examination of two samples of condensed mare's milk from Samara, I had the opportunity of analysing lately.

1. Sample, contained in a tin, similar to those containing Condensed Swiss Milk. Colour: not quite pure white; consistency: very thick, if taken out by means of a glass rod sticking to the same and not flowing off; smell: sweet, aromatic, resembling that of honey; taste: some people think it not at all objectionable, others find it disagreeable, disgusting and irritating.

2. Sample, contained in a wide-necked glass bottle, corked and waxed. Qualities on the whole the same as in the previous case, but colour more yellowish, smell and taste less pure, somewhat rancid.

The condensed milk readily dissolves in warm water, yielding a liquid of milky appearance. The composition of the two samples was found to be as follows:—

	Sample 1.	Sample 2.
Water	17·90 per cent.	18·80 per cent.
Solids	82·10 ,,	81·20 ,,
Fat	12·07 ,,	10·08 ,,
Protein	13·50 ,,	15·23 ,,
Sugar	51·88 ,,	54·09 ,,
Ash	1·65 ,,	1·80 ,,

By these figures it appears that the milk was reduced to the seventh part of its original bulk by concentration. After having concluded my analyses, I learned that the degree of concentration was really this, and that 2·33 per cent. of cane sugar had been added to the mare's milk. Taking in account these facts, the composition of the milk employed would have been as follows:—

	Sample 1.	Sample 2.
Water	90·39 per cent.	90·52 per cent.
Solids	9·61 ,,	9·48 ,,
Fat	1·76 ,,	1·47 ,,
Protein	1·97 ,,	2·23 ,,
Sugar	5·63 ,,	5·51 ,,
Ash	0·25 ,,	0·27 ,,

Four samples of mare's milk analysed by Landowski and Biel, were of the following composition:—

	Landowski.	Biel.		
Water	89·29 per cent.	90·26 per cent.	90·62 per cent.	90·38 per cent.
Solids	10·71 ,,	9·74 ,,	9·38 ,,	9·62 ,,
Fat	1·16 ,,	1·26 ,,	1·11 ,,	1·56 ,,
Protein	1·87 ,,	2·85 ,,	2·78 ,,	2·02 ,,
Sugar	7·32 ,,	5·34 ,,	5·21 ,,	5·73 ,,
Ash	0·36 ,,	0·29 ,,	0·28 ,,	0·31 ,,

The large amount of milk sugar present in mare's milk renders it possible to abstain from adding a large quantity of cane sugar, and the high degree of concentration admits of the assumption that condensed mare's milk will keep without decomposition for some length of time if contained in air-tight closed vessels.

ON THE PRESENCE OF COPPER IN CEREALS.

By Edward F. Willoughby, M.B. (Lond.)

For more than half a century a belief or suspicion has existed that bakers occasionally resorted to the use of copper sulphate with the same aim as that with which they more frequently employ alum, viz., to produce a fine looking white bread out of damp and damaged flour. That the notion has not been entirely groundless was shown by the conviction of Belgian bakers in 1843 and in 1847, and of one at Calais not long since, but there is no evidence that the fraud has ever been perpetrated in this country; although, if proved, it would no doubt be punished with the utmost rigour.

On the other hand it has been at various times asserted that copper is, or at least may be, present in flour as a normal, or more correctly a natural, constituent derived from the soil, and when we consider the extreme delicacy of our tests, we must bear in mind the possibility of mistaking such quasi-normal presence for a fraudulent addition.

Vauquelin, nearly sixty years ago, believed that he detected copper in the ashes of some plant, but the discovery seemed so incredible that he did not venture to publish it at the time. From 1828-1830 Meisner gave in the *Journal de Pharmacie et de Chimie* the results of a series of analyses of various plants containing copper. In 1500 grammes of wheat he found 0·007, and in the same weight of flour 0·001 gr. of copper. These proportions he believed to be under the truth, since the process he employed involved some loss of the metal.

Between 1830 and 1833 Sarzeau and Boutigny, working independently, verified the presence of copper in the proportion of 0·0016 in a kilogramme of wheat, and of 0·0006 in one of flour. They found that it resided chiefly in the bran, and that consequently the coarser and browner flours contained more than the finer, whence Sarzeau suggested that it might exist in the form of a phosphate. Chevreul cast doubts on their conclusions, since he failed to find it in some cases, and considered it to be an accidental contamination through careless manipulation. J. Hopff (*Vackenroder Arch. f. Ph. LXVI.*, 140) had shown that plants may be made to absorb considerable quantities of copper by watering them with a solution of the sulphate, although in so doing they lose health and ultimately perish. The presence of copper in cereals might plausibly be attributed to the practice of washing the seed corn with copper sulphate in place of lime with a view to the destruction of vermin, but in a paper read before the Academy of Medicine in January, 1848, M. Deschamps of Avallon proved its presence in the produce of a field which had belonged to the same proprietor for forty-two years, and to which copper had never been thus applied. (*Bulletin de l'Acad. de Med. XIII.*, 542). Among the results given in this paper are the detection in a kilogramme of wheat 0·001, of potatoes 0·00284, of potato starch 0·0008, and of rice 0·00613 gramme of copper. He supposes the copper in the soil to be derived either from the detrition of metalliferous primary rocks or from the decomposition of iron pyrites containing an admixture of cupric sulphides and carbonates. Analyses showed that the "calcaires à gryphées arquées," the belemnitic limestones, ferruginous sands and the particles of ferrous oxide which abound in the marls overlying the first mentioned limestones all contained copper. He imagines that the copper exists in the soil for the most part as a carbonate, which, being soluble in ammonium carbonate, is absorbed along with it by plants in the form of a cupric-ammonio-carbonate, and on the breaking up of the molecule and fixation of the nitrogen in the tissues the metal is set free. He thus accounts for the larger amount found in the more nitrogenous structures as the testa or bran. The use of cupric sulphate for "liming" the seed corn year after year adds enormously to the copper, if any, originally present in the soil.

Going back to the year 1831, we find Kuhlmann contributing to the *Ann. d'Hyg. et de Med. leg. V.* 339. "Considerations sur l'emploi du sulphate de cuivre et de diverses matières salines dans la fabrication du pain." He stated that the end for which it was used was attainable by adding one part of cupric sulphate to 30,000 of flour (equal to one part of metallic copper in 300,000 of bread) though with flour but slightly damaged one in 150,000 parts might be enough. The first named proportion could not be surpassed with impunity, for 1 in 4,000 gave a sodden bread, and 1 in 1,800 completely arrested fermentation, and imparted a greenish tinge.

Kuhlmann asserts that he had obtained from several bakers admissions as to its use, of course in the smaller proportions, which, though they could scarcely be deemed noxious, he held to be fraudulent as permitting the use of inferior flour, though Dr. du Moulin, among others, justified the practice as a means of avoiding a diminution of the national food supply.

The subject seems to have been almost entirely neglected until last year, when M. J. Van del Berghe, director of the laboratory of the Provincial Agricultural Laboratory of West Flanders published in the *Bulletin de la Societe de Medecine de Gand*, and the *Journal des Connaissances Médicales*, April 20, 1882, notes on the presence and estimation of copper in bread. Suspecting the presence of copper in the bread he used daily, he made analyses of samples from three of the best bakehouses in Ghent, and found it in each. Surprised at these results, he examined several samples of wheat which gave a very similar proportion, viz., 0·0058 grammes of sulphate in 500,000 grammes, or 9·21 in a million of metallic copper. Still thinking it might have been derived from "liming," he analysed 250 grammes of oats which he knew had not been so treated, and found 0·0034 grammes of the sulphate, or 10 3 in the million of metallic copper, a considerably larger proportion than existed in the wheat or bread. His reagents were absolutely pure, yet every sample of bread examined contained from 8 to 10 parts of copper in the million, which he concluded was not added in baking, but pre-existed in the grain. M. Van del Berghe conceives it to be of the highest importance that the amount of copper that may exist normally in wheat should be determined in the interest of the public, as well as what amount, if added, would be injurious to health.

Dr. V. Galippe has conducted like analyses on a larger scale, with the results shown in the following table:—

	Copper in a kilogramme.
Wheat from Central France	0·0100
" " la Châtre (Indre)	0·0080
" " Grandvilliers (Oise)	0·0052
" " Michigan	0·0070
" " American, Redwinter	0·0085
" " California	0 0050
" " Native Brie	0 0054
" " American soft	0·0108
" " Russia, hard Taganrog	0 0088
" " Algiers, hard	0·0062
Rye	0 0050
Oats	0·0081
Barley	0·0108
Rice	0·0016

All the wheats except that from la Châtre also contained manganese.

The mean of Dr. Galippe's analyses gave for the bran 0·014 gr. per kilogramme, and for the farina 0·0084 of copper. He examined next the bread supplied by the poor law authorities and to the troops: the former contained in the kilogramme max. 0·0055, min. 0·0044, mean 0·0047; the latter, max. 0·0080, min. 0·0036, mean 0·0048.

Various samples of the bread sold in the shops averaged 0·0044. Rye bread, max. 0·0044, min. 0·0015, mean 0·00246. Oatmeal 0·0042; and, lastly, English bread only traces. Is this due to the less general use in this country of washing with sulphate of copper, or to the mere accidental selection of a sample?

SELENIUM IN COMMERCIAL SULPHURIC ACIDS, AND ITS ACTION ON SHALE OILS.

By James Hamilton.

In connection with the Paper on this subject published in our last number, the following, which was lately read before the Royal Physical Society of Scotland, will be of interest:—

Before entering into the subject of the action of selenium on mineral hydro-carbon oils, it may be not uninteresting if I were to give a short sketch of the production and manufacture of these oils, and the manner in which selenium would be liable to affect them. The shale from which the oil is produced is brought directly from the pits or mines where it is found to the retorts. In this state the size of the pieces of shale is very unequal, and to render them of a comparatively equal size, and also to enable the oil vapours to escape more easily from it, the shale is put through what is known as the "breaker." From the breaker the shale is put into the retorts. Various kinds of retorts are used, the three commonest forms being the Henderson patent, the vertical, and the Young & Beilby, all possessing attributes suitable to the different kinds of shale. In all these retorts, steam, either superheated or soft, is used. The products of this distillation are oil, ammonia-water and an uncondensable gas, which latter is brought back to heat the next charge of shale. The ammonia-water is separated from the oil, and by one or another means the ammonia in it is converted into sulphate of ammonia.

The oil more particularly concerns us. From the receiving tank of the retorts it is pumped into a charging tank, and from this charging tank is run into stills, which are generally known as the "crudes." In this distillation, as in all distillations throughout the process, varying percentages of steam are used. The distillate is only slightly fractionated, naphtha being separated. The oil is now known as "once-run oil."

From the receiving tank of the crude stills the oil is pumped into a "washer"—a washer being a suitable vessel, able to contain from 500 to 2,000 gallons, the contents of which may be stirred either by air or by some mechanical means. On the oil in the washer sulphuric acid is run, and the contents agitated as long as is necessary to saturate the acid with tar. This tar is run off, and a second quantity of acid is added. In like manner this also is agitated, allowed to settle, and the tar run off. This process is continued until all the tar which it is advisable to separate at this stage is carried off. At the end of the last agitation the oil is allowed to settle for about three hours, in order to allow the tar more completely to separate. After settling for this length of time, the oil is run into what is known as the "soda washer," where it is treated with a strong solution of caustic soda, in order to neutralize any acid which may be left in the oil, and to prepare the oil for another distillation.

From the soda washer the oil is pumped, blown by means of air-pressure, or run into the second-stage boilers or stills; from these stills it is fractionated into a light portion, sp. gr. about ·828, which contains little or no solid paraffine, and a heavier portion, sp. gr. about ·877, which at 60° Fahrenheit, is solid with paraffine. The light portion is taken and treated with acid and soda, as before, and is then again distilled. The distillate is fractionated into ·84, ·85 oil, and oil at about ·805 sp. gr. It may be as well to mention here in order to avoid repetition, that the heavy fractions at the end of light oil distillations are mixed with the light fractions at the beginning of the distillation of the heavy portion, and thus carried on to the finished state. Thus, the ·84 to ·85 oil is mixed with the ·84 to ·85 oil from the beginning of the distillation of the heavy portion, and they are both washed together, and then form what is known under the various names of marine oil (from its application to ships' lamps), mineral colza, or under the common-place title 840/50 oil. It is somewhat a waste product, perhaps its principal use just now being 840/50 bloomless for the adulteration of rape and other high priced vegetable oils. If the ·805 fraction is wanted as "crystal oil," it is treated with acid and a weak solution of soda, and after washing with water it is ready for the market.

If it is wanted as No. 1 burning oil, it is washed with acid and a strong solution of soda, again distilled, and without treatment it is ready for the market. This process may seem curious, but the idea is to get as good a light from the No. 1 burning oil as from crystal oil, without the same crusting of the wick occurring as in crystal oil, due to the presence of minute traces of sodium sulpho-olefines. The heavy portion, containing the solid paraffines, is taken in a liquid state to the paraffine sheds, where paraffine of a melting point about 118° Fahrenheit is taken from it by means of a freezing machine, filter presses, and hydraulic presses. This crude or green scale contains about 4 per cent. oil and 2 per cent. dirt and water, and is the substance most largely used in the manufacture of paraffine candles.

The oil pressed from this green scale is known as blue oil, and after the separation it is taken and treated with acid and soda as I have previously described. From the washer it is pumped into what is known as the lubricating or "lub" stills, and is there fractionated practically into ·865 and ·885 oils. I may mention that, in order to bleach the oil it is treated with solid caustic soda in the stills—that is, solid caustic soda is hung in the still in order that it may bleach the vapor as it is formed. These ·885 and ·865 oils are either washed with acid and a weak solution of soda, and thereafter the low-melting-point separated, or the paraffines are first separated and they are then washed. The paraffine from the ·865 oil has a melting point of about 95° Fahrenheit, and that from the ·885 oil of about 100° Fahrenheit. In order to separate these paraffines, the oil has to be frozen down to about 18° Fahrenheit.

We now come to the action of selenium upon the oils. About two months ago a discoloration was noticed in some burning oil in the process of manufacture, and before long the same discoloration was noticed in the whole of the oils, both heavy and light. There are many things which might have caused this discoloration, among others, under treatment with vitriol in the first stages, or vitriol which contained nitric acid as an impurity being used in the later stages. In order to prevent confusion hereafter, I will call sulphuric acid by its commercial title, vitriol.

As in our works the first of these causes was carefully noticed and prevented, this cause was at once put aside; but in regard to the latter, we were not equally certain. The vitriol from our stock gave decided traces of nitric acid, and of course we at once blamed that impurity; but as we are supplied from two vitriol works, it could not be decided till further supplies of the acid arrived, who was the erring party. Next day two tanks of vitriol came in from the different makers. One of them showed distinct traces of nitric acid, with both the ferrous sulphate and indigo tests. The other gave the indigo, but not the iron test. They both were, of course, at once rejected, but the second is the one with which we were more particularly concerned. Why it should give the indigo and not the iron test was rather a mystery. On receiving our notice of rejection, the makers at once sent out and sampled the acid, and thereafter sent the sample to an Edinburgh chemist, who reported that it only contained ·005 per cent. of nitric acid by the nitrometer, an instrument which I had not by me at the time.

This result puzzled us considerably, and we went on using the acid, attributing the bad color in the oils to a tank of the other maker's vitriol, which by some inadvertence had been allowed to pass into the refinery. Three days were allowed to elapse, when, in place of the oil getting better in colour, it grew worse. The supply of both these makers' acid was then stopped, and an acid which we knew to be pure used in the refinery. I told my friend, Mr. Hunter, of our difficulties with the oil, and of my opinion that there was something seriously wrong| with the acid which had given the indigo and not the iron reaction. He advised me to bring in a sample, and we would examine it together. One of the results of this examination was, that it contained practically no nitric acid, and yet it gave the sulphate of indigo reaction; the other result was that there was something foreign in the sulphuretted hydrogen precipitate, as it was reddened to a considerable extent. A portion of this precipitate, with gentle heating, almost completely dissolved in ammonium sulphide, leaving a very slight black residue, which was at the time thought, and afterwards proved to be, lead. Another portion was boiled with ammonium carbonate, when the yellow arsenic sulphide dissolved, and left a reddish-brown residue, which was reduced by the action of stannous chloride. This strange residue was at once put down as the cause of our oil going back in colour, but we had not at that time sufficient leisure to go into the matter further. In the mean time our oil had come back to its original colour, with the acid which we knew to be free from any impurities, and this of course almost conclusively proved that there was no fault in the process. But, in order to further prove that it was the faulty acid which had done the damage, it was again allowed into the refinery, when the same symptoms were noticed. As this could not be allowed to go on, an official sample of the acid was sent to Mr. King and Mr. Hunter, when they in a few days reported that the only thing that was peculiar about the acid was the presence of an element resembling selenium, and which they thought was selenium. On further examination the impurity was conclusively shown to be selenium, and further, that it had a very injurious action upon oils.

This property of selenic acid, the state in which there can be no doubt the selenium exists in the vitriol, of acting upon mineral hydro-carbon oils has, as far as I am aware, never before been noticed—the usual bugbear being nitric acid, which, in the case of this vitriol, was shown to be entirely absent. What its exact action is, is rather difficult to say. But the most likely explanation of its action is, that during the process of treating the oils with vitriol it forms a selenated olefine, which, during the washing with soda, is converted into a sodium-seleno-olefine, and this body, on exposure to air either reddens in color itself or acts on the oil in such a manner as to give it a red color. This is, we know, what happens with sulphuric acid, when the oil is over-treated. But in the case of over-treatment with sulphuric acid the evil is completely removed in the next distillation, while with selenium it is not, as the selenium compound distils over along with the oil and dissolves in it. This was particularly noticed at the worm ends of the burning oil stills, where, when the oil should have been white, it was yellow to no inconsiderable extent.

This occurrence of selenium in sulphuric acid, and its action upon oils, is as important as it has hitherto been obscure; important, in so far as by its presence thousands of gallons of oil have been practically rendered unmarketahle, and so obscure as to have misled the foremost of our oil-works managers and the leading chemists in the oil industry. In the benefit accruing to the oil trade from this investigation, personally, I claim but little, but, at the same time, there can be no doubt that the results are of the greatest importance, not only from an intrinsic, but also from a scientific point of view; and if, in the credit that is going, I am only bracketed with Mr. King and Mr. Hunter, I shall be more than repaid for the part I have taken in the inquiry.

FOOD ADULTERATION IN FRANCE.

The following Analyses were made at the Paris Municipal Chemical Laboratory, during the month of March, 1888:—

Nature of the Samples Analysed.	Good.	Passable	Bad.		Totals
			Not Injurious	Injurious.	
Wines	79	89	349	5	522
Vinegars	—	2	—	—	2
Beers	6	1	4	—	11
Ciders	2	1	5	—	8
Alcohols and Liqueurs.	1	—	1	6	8
Syrups	—	—	1	—	1
Waters	3	6	—	6	15
Milks	26	116	115	—	257
Malt	3	—	—	—	3
Butters	7	2	10	—	19
Oils	1	—	13	—	14
Flours	22	—	3	—	25
Dough, Bread	11	3	1	1	16
Sweetmeats	1	—	—	—	1
Meats	1	1	—	—	2
Preserves	17	—	1	5	23
Salt, Pepper	20	1	26	—	47
Chicory, Coffee, Tea	9	1	—	1	11
Chocolates	14	1	12	—	27
Honeys	—	—	—	—	—
Confitures	—	—	1	—	1
Colouring Materials	1	1	—	4	6
Toys	—	—	—	19	19
Coloured Papers	3	—	—	1	4
Tins	7	—	—	1	8
Pharmaceutical Preparations	5	—	—	—	5
Perfumery	2	3	—	2	7
Various	30	3	3	20	56
TOTAL	271	231	545	71	1,118

LAW REPORTS.

Raid on Coffee Dealers—Heavy Fines :—

At Huddersfield, on Wednesday Feb. 7th, Edward Teal, grocer, King Street, and Alex. Wallace, grocer, Buxton Road, were charged with selling adulterated coffee, and which were adjourned from the previous Wednesday, came on again for hearing. Mr. D. F. E. Sykes appeared for both the defendants. The case of the defendant Teal was taken first. The analysis showed 50 per cent. coffee, and 50 per cent. chicory; while the defence was that the sample was sold as a mixture, that the proportions were 3 of coffee, 2 of chicory, and 1 of dandelion coffee, which was a fair mixture; and that the wrapper bore a label stating that the article was sold as a mixture, which protected the vendor under the Act. The reply was that the mixture of chicory was unreasonable in quantity, and was added to increase the bulk.—Some conversation took place between Mr. Kirk (sanitary inspector), Mr. D. F. E. Sykes, and the Bench, as to the reason why this case was adjourned for the purpose of a part of the sample being sent up to Somerset House for further analysis. Mr. Kirk said he afterwards found that the sample could only be sent through the justices, and therefore it could not be sent: but Mr. Jarmain had again analysed the sample. The Magistrates' Clerk also said that before the sample could be sent to Somerset House application should be made to the Magistrates.—Mr. Jarmain was re-called, and said he had made a further examination of the mixture without having succeeded in obtaining results different from those obtained last week. He had examined pure chicory and pure dandelion under the microscope, and there was very little difference between the two in appearance. That difference he did not find in the sample of coffee in question. He did not find the slightest trace of dandelion in the coffee.—Cross examined: Chicory and dandelion belonged to the same family or order of plants, and the roots were almost identical. It might be that he could not distinguish between chicory and dandelion in the sample; the difference was so slight as to make it difficult to trace when the two were mixed with coffee. There could be only one-sixth dandelion, according to the evidence for the defence.—By the Bench: Supposing an equal bulk of chicory and dandelion root, after being roasted, were mixed together, he could not tell the exact proportion of each under the microscope. The density of the articles, in which there was very little difference, helped him in determining the quantity.—By the Magistrates' Clerk: He did not say there was no dandelion in the sample, but he had not found it. And he used all the best means for ascertaining it.—Re-examined: He gave a penny an ounce for the dandelion root he now produced.—Mr. Sykes said, the defendant, mixed the dandelion, knowing that it cost more than chicory or pure coffee, and intending that the dandelion should count not as chicory, but coffee; therefore there was no fraud.—The Mayor said the Bench had considered the case fully, and had come to the conclusion that as coffee was in great consumption amongst poor people, it was necessary that they should be protected. They fined the defendant £5 and £1 8s. costs.——In Alexander Wallace's case Mr. Sykes said the evidence was that the agent of Mr. Kirk went to the shop of Mr. Wallace, and asked for a quarter of a pound of 16d. coffee. On analysis it was found to contain 33 per cent. of chicory, and only 17 per cent. of coffee, and there was no label upon the packet showing that the article was sold as a mixture of chicory and coffee. Well, it looked about as bad a case as a man could well imagine, and the analysis was so contrary to his instructions that he asked for an adjournment for further inquiry to be made into the matter, as Mr. Wallace was unwell and unable to attend. Inquiry had been made, and he should call witnesses who would give such an explanation as would leave the defendant technically guilty but morally blameless. He should prove that the defendant gave written instructions to Mr. Harrison, the manager at the shop in question, as follows:—" For sixteenpenny coffee, mix 75 per cent. of coffee and 25 per cent. of chicory "—25 per cent. being the quantity that Mr. Jarmain considered a fair admixture.—The Bench: It is not Mr. Jarmain's advice.—Mr. Kirk: Oh, dear, no; it is inadmissible in law.—Mr. Sykes added that the defendant's instructions also said that the mixture was to be wrapped in a wrapper similar to the one he (Mr. Sykes) now produced, bearing the printed label " This is sold as a mixture of chicory and coffee." Had those instructions been complied with, the defendant could not have been prosecuted for selling the mixture without notice to the public that it was a mixture, nor could he have been successfully prosecuted for fraudulently increasing the bulk, because that was a fair mixture. The defendant had given instructions that in future all his coffee should be mixed by his son at his central establishment, and shall not be left to the manager.—The defendant and his manager gave evidence bearing out the foregoing statement, and the canister bearing the defendant's instructions as to the mixing was produced.—The Mayor said the Bench considered this a very bad case indeed, and they could not inflict a less penalty than £10. The only question with them was whether they should not inflict the full penalty. However, they had decided to fine him £10 and £1 8s. costs.

Fine for Selling Butterine as Butter.

At the South Staffordshire Stipendiary's Court, held at Wednesbury, several important cases under the Sale of Food and Drugs Act were brought forward by Mr. Horder, the inspector. The first case heard was that against Mr. J. Price, wholesale and retail grocer, of Bilston, who was summoned for selling butterine as butter. Mr. Dallow appeared for the defence. Wm. Watson stated that when going through the Bilston Market, he met Mr. Toy, assistant to Mr. Horder, who requested him to go to the defendant's stall and ask for a pound of butter. He did as he was requested, and on arriving at the stall (which was a large one), he noticed placards on the top of the stall, "A drop in Butter," and "Butter down again." He asked for a pound of butter, and tendered a half-crown in payment, receiving 1s. 8d. in change. Cross-examined by Mr. Dallow: He had not yet been paid for purchasing the butter, neither was he engaged by Mr. Horder. He accidently met Toy in the Market Place, and he requested him to go and purchase the butter. He would swear most positively that he asked for butter. He did not ask the price of the article with which he was supplied. There were no tickets on the article. Mr. Toy stated that on receiving the article from the last witness he saw the defendant's assistants, and informed them that he was going to have the article analysed. The article was afterwards conveyed to Mr. Jones, the county analyst, who reported that the article contained 10·05 per cent. of water, 2·12 of salt, 1·11 of curdy matter, and 86·72 of animal fat. In reply to the Stipendiary, Mr. Jones stated there was only a mere trace of butter. It was an article known as butterine and consisted chiefly of refuse animal fat. He had heard of so-called butter being made of Thames mud. He would not, however, state that the article in question was made of Thames mud. By Mr. Dallow: The article was not in any way injurious, and might not act injuriously upon a sick person. He could not positively say that butterine was an article of commerce. He did not know that there were recognised places where butterine was manufactured. He had heard of it being manufactured at Rotterdam. It was said to be made from beef fat. Mr. Dallow submitted that the article was sold as butterine, and Watson was distinctly told when he made the purchase that the article was butterine, and not butter, and he therefore very respectfully submitted that no case had been made out against his client. He afterwards called Thomas Price, the son of the defendant, who said he was at the stall when Watson came up to it. On the stall were tubs of butter and butterine. They were, however, separate. It was true that there were notices over the stall, "Butter down again," and also "A drop in butter." Watson, pointing to a tub of butterine, said, "I want a pound of this." He did not say anything about butter. By Mr. Horder: It was not possible to buy butter at 10d. per lb. at the present time. Salt butter ranged from 1s. to 1s. 4d. per lb. At this time of year, if tradesmen had large stocks of butter in their cellars, there was no doubt they would sooner sell it at a sacrifice rather than keep it, as the first loss was always the best. He was fully justified in putting up the notices which had been referred to by the witnesses, as butter was always up and down in price. The notices were, however, posted over the butter, and not over the butterine. He would swear, and most positively, that there was a large quantity of butter on the stall.—Henry James, an assistant, gave corroborative evidence, and two customers, who happened to be standing at the stall when Watson made the purchase, stated that he distinctly asked for a pound "of this." The Stipendiary said, notwithstanding the evidence which had been called for the defence, he was convinced that in law an offence had been committed, because he was sure that, as Watson had a special object in view, he he would not ask for "a pound of this," as stated by the witnesses, but would ask for a pound of butter. He certainly considered that butterine should be ticketed butterine, and then there would be no mistake about it.—The defendant was fined £2 and £2 4s. costs.

The Sale of Spirits under the Strength indicated on the Labels.—Strange Decision :—

At the King's Lynn Petty Sessions, on the 16th April, Messrs. Ladyman & Co., grocers, agents for Messrs. W. & A. Gilbey, were summoned before the magistrates for selling three samples of spirits not of the nature, substance and quality demanded. The charge was brought by Mr. Ware, the superintendent of police, and inspector under the Act. Mr. Ware conducted the prosecution; Mr. Poland, barrister of London appeared for the defendants. Sergt. Taylor stated that, on the 15th March, he went to Ladyman & Co's. for a bottle of rum, for which he paid 2s. 3d. The rum supplied, the assistant directed his attention to the label on the bottle, which stated—"The strength being 33 per cent. under proof by distillation, it is suitable either for mixing with water, or as a digestive or stimulant with dilution." Witness also bought a bottle of gin from a rack labelled "Gin," which was described as "household gin, unsweetened; the strength being half strength (50 per cent. under proof) by distillation," and a bottle of Scotch whiskey, labelled as "Proof." Mr. Ware said the next evidence was simply to put in the Analyst's certificates. Mr. Poland objecting, referred the magistrates to the 21st section of the Act, and as that requirement had been made, the certificates were not evidence without the Analyst being called. Mr. Johnstone said he was Analyst for the borough, and on the 15th of last month the Inspector arranged to send him samples of spirits for analysis, and the same day he received three bottles marked "Rum, Gin, and Scotch Whiskey" from Sergt. Taylor, and he declared the results of the analysis to be, Rum 35·90 degrees under proof, Gin 52·30 degrees under proof, and the Whiskey 4·45 degrees under proof. On cross-examination, as to the process which he adopted for testing the spirits, he declined to enter into any explanation of the methods he employed, or to describe processes of analysis. Mr. Poland then addressed the Bench for the defence, stating that the case was one of much importance to the real defendants, Messrs. Gilbey, and that there had not been a conviction recorded against them in the course of their business, at the same time remarking that he was rather surprised that the Lynn Analyst should not have readily understood what proof spirit was (Mr. Johnstone: It is not what you think it is); it was notorious what proof spirit was, and it was not mere obstinacy on the part of the Analyst, but it was a degree of ignorance to say that proof spirit was not half pure spirit, and half distilled water by weight, tested by Sykes' hydrometer. Mr. Tyler, of the firm of Charles W. Tyler & Co., wine testers, was next called, and stated that the *Public Test Office* was in Little Tower Street, City, and that he had made a careful analysis of the three samples by means of Sykes' hydrometer, and that his results were Rum 37·4 under proof, Gin 50·8 under proof, Whiskey 3·2 under proof, and that the testing of the liquors was very simple. After several other witnesses were called, the magistrates retired to consider their decision, and returning into court, the Mayor said: In this case the magistrates consider the charge against Mr. Ladyman as to the Rum and Gin be dismissed, but with regard to the Whiskey we consider the variance too great, and convict Mr. Ladyman in the penalty of 40s. and costs. Mr. Poland gave notice of appeal to the Court of Quarter Sessions at Lynn, and asked the court to fix the recognisances required. The Mayor said he would accept Mr. Ladyman in £100 and two sureties of £50.

Milk and Fifty per cent. of Added Water.

David Barnard, a dairy farmer, of Oaks Farm, Chigwell, was summoned at the Stratford Police Court, at the instance of Captain Rittoe, an inspector under the Food and Drugs Act, for having, through his nephew, sold a pint of milk which, upon analysis, proved to be adulterated. Mr. Willis appeared for the prosecution, and said this was one of the very worst cases that had ever come before the bench. Captain Rittoe stated that on January 6th last he met the defendant's nephew at the Chigwell Lane Station, having in his possession a quantity of milk consigned to a Mr. Abbot, of Leytonstone. Witness purchased a pint for 3d., and divided it into three parts, one of which, upon being sent to the Public Analyst, was certified to having been adulterated to the extent of 50 per cent. of added water. Mr. Atkinson said that the defendant on his advice would plead guilty, but he wished a few facts to be taken into consideration. Mr. Barnard had a cow that was addicted to kicking, and it had on several occasions upset some milk. A lad was directed to tie the cow's legs, but he did not do so, and the animal kicked over more milk, whereupon the lad, afraid of getting into trouble, made up the quantity with water. The lad was called and proved this, and in cross-examination said he got the water from one of the pumps, which were "all over the yard." The bench thought this a very bad case, and imposed a fine of £7 10s. and costs, £7 19s. in all. The money was paid.

RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

No. 1882	Name of Patentee.	Title of Patent.	Price.
2512	E. W. Beckinsale	Incandescent Electric Lamps	2d.
3705	J. L. Somoff	Electric Lamp	4d.
3713	E. G. Brewer	Electric Arc Lamps	8d.
3756	T. J. Handford	Dynamo or Magneto Electric Machines	6d.
3770	L. Epstein	Preparation of Lead for Secondary Battery Cells	4d.
3773	J. Imray	Sulphites and Bisulphites for Bleaching Purposes	6d.
3779	B. J. Mills	Electric Lamps	8d.
3789	E. A. Brydges	Oxidising Alcohols, &c.	8d.
3802	C. T. Kingzett	Secondary Batteries	4d.
3812	J. S. Beeman, W. Taylor and F. King	Secondary Batteries	6d.
3814	H. J. Haddan	Electric Lamp Apparatus	6d.

No. 1882	Name of Patentee.	Title of Patent.	Price
3821	F. Mori	Electric Lamps	4d.
3822	Ditto	Batteries for Storage of Electricity	2d.
3825	S. H. Emmens	Electric Motors	2d.
3835	P. & F. M. Spence	Alum and other Salts of Alumina	4d.
3856	W. R. Lake	Electric Lamps or Lighting Apparatus	2d.
3861	G. Pfannkuche and A. A. Dixon	Electric Incandescent Lamps	2d.
3869	E. Desfossé	Dynamo Electric Motor Machine	4d.
3891	H. Ulsmann	Manufacture of Basic Fireproof Materials from Alkaline Earths	4d.
3893	H. J. Haddan	Secondary or Storage Batteries	2d.
3606	W. R. Lake	Electric Lamps	6d.
3941	N. C. Cookson	Secondary Batteries	2d.
3950	S. G. De Ferranti and A. Thompson	Dynamo Electric Machines	6d.
3955	T. J. Handford	Incandescing Electric Lamps	6d.
3961	Ditto	Secondary Batteries	6d.
3961	H. T. Barnett	Secondary Batteries	6d.
3975	J. E. T. Woods	Secondary Batteries and Electric Accumulators	4d.
3976	T. J. Handford	Electric Lights	6d.
3977	D. Urquhart	Manufacture of Ammonia and Purification of Shale Oils	4d.
3991	T. J. Handford	Incandescing Conductors for Electric Lamps	4d.
3999	G. Johnson	Recovery of Caustic Soda or Potash, Employed for Extraction of Arsenic from Copper Precipitates	2d.
4017	H. J. Haddan	Manufacture of Hydrate of Glucose from Starch	4d.
4046	J. D. Mackenzie	Electric Arc Lamps	6d.
4057	E. P. Alexander	Manufacture of Ammonia and Bone Black	6d.
4079	L. H. M. Somzée	Secondary Batteries	6d.
4065	C. S. Snell	Electric Lamps	2d.
4084	P. R. Allen	Arc Electric Lamps	6d.
4107	C. F. Clans	Manufacture of White Pigments, Alkalies, &c.	4d.
4131	Ditto	Manufacture of Silicate of Zinc, Lead, Baryta, and Strontia	4d.
4144	W. L. Wise	Manufacture of Caustic Potash and Soda	4d.
4178	D. G. Fitzgerald and T. J. Jones	Secondary or Storage Batteries	4d.
4180	J. Jameson	Carbons for Incandescent Electric Lamps	4d.
4186	L. Hartmann	Construction of Voltaic Batteries	2d.
4224	W. L. Lake	Manufacture of Starch	6d.
4226	W. Green	Manufacture and Treatment of Soaps	4d.
4238	W. Crookes	Incandescent Lamps	6d
4250	T. Donnithorne	Dynamo Magneto Electric Machines	4d.
4254	F. W. Durham	Voltaic Batteries	2d.
4266	T. Slater	Storing Electric Energy	2d.
4303	E. Frankland	Electrical Storage Batteries	4d.
4376	M. Deprez	Dynamo Electric Machines	8d.
4717	J. Gordon and J. Gray	Disc Dynamo and Magneto Electric Machines	6d.

BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Practicien; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review.

THE ANALYST.

JUNE, 1883.

SOCIETY OF PUBLIC ANALYSTS.

A General Meeting of this Society was held at Burlington House, on Wednesday, the 30th May, the President, Mr. Wigner, in the chair.

Messrs. Kingzett and Baines were appointed Scrutineers to examine the voting papers, and announced that the following had been elected: As Members—B. A. Burrell, of Leeds, Public Analyst for Cork, and H. B. Turner, of Massachusetts, Analytical Chemist. As Associate—R. Bodmer, Assistant to Dr. Stevenson.

The following were proposed for election: As Member—Edwin Lapper, L.K. and Q.C.P.L., Dublin. As Associate—F. Smith.

The following papers were read and discussed:

"Note on the use of Butter, Milk, and Mammary Tissue in the Manufacture of Butterine," by C. Meymott Tidy, M.B., F.C.S., and G. W. Wigner, F.C.S., F.I.C.

"Contribution to the Examination of the Fixed Oils," by W. Fox, F.C.S.

"On the most simple and generally useful Mode of expressing the Results of Water Analysis so as to be universally comprehensible, with Examples drawn from London Water, and also from a Case of Typhoid Epidemic," by John Muter, M.A., Ph.D., F.I.C., &c.

The next Meeting of the Society will be held at Burlington House, on Wednesday, 27th June.

Errata.—On pages 53 and 73 the name, Dr. Davenport Hill, Public Analyst, Massachusetts, *should be* Dr. B. F. Davenport, Public Analyst, Boston.

ON THE MOST SIMPLE AND GENERALLY USEFUL MODE OF EXPRESSING THE RESULTS OF WATER ANALYSIS SO AS TO BE UNIVERSALLY COMPREHENSIBLE; WITH EXAMPLES DRAWN FROM LONDON WATER, AND ALSO FROM A CASE OF TYPHOID EPIDEMIC.

By John Muter, M.A., Ph.D., F.I.C., &c.,

Since the old method of igniting the residue and calling the loss on ignition "organic matter" was exploded as not sufficiently accurate for modern chemical ideas, the general non-scientific public have been deprived of any simple idea which they can grasp as indicating the degree of organic impurity present in any sample. This has been frequently strongly brought to my notice, even in cases where medical officers of health were engaged, who might be supposed to be able to interpret "albuminoid ammonia" and "oxygen consumed." Some time ago one of the local board committees for which I work, actually passed a resolution that in all future water analyses I should be requested to state the actual amount of organic matter present in the samples submitted to me, thus compelling me to perform what is at present impossible. If, however, some scheme of expression of the nature of a valuation were generally adopted by analysts, this difficulty would be overcome. Such an idea has been already before us in Mr. Wigner's most excellent proposals for expressing in figures the full valuation of a water based upon every point which could possibly affect the character of the article, and I believe, had we had more time to thoroughly try and put our minds to such a scheme, it would have been carried in a modified form instead of being, as it was, somewhat cavalierly rejected. As far as I can see from increased experience, one great cause of the failure of Mr. Wigner's scheme to commend itself to universal adoption, was that it attempted to do more at the moment than chemists were as a body prepared for, and in labouring to bring it as near perfection as possible its author sealed its fate in the minds of those conservative persons who are always alarmed by any radical change. I have now for nearly three years carefully applied Mr. Wigner's ideas to every sample of water which has passed through my hands, with the result that I have been led to more and more believe in them as a whole, but gradually to abandon certain portions which I have found of little consequence. After all, when we divest water analysis of mineral considerations, and of theoretical impurity based on the presence of certain such constituents, we are brought to the two "ammonias" and the two "oxygens consumed" as the real measure of the active organic impurity. I am not going to deny that in special cases an analyst who deliberately shuts his eyes to the nitrates, chlorides, and general mineral constituents of a water, commits a grave dereliction in duty; but on the other hand, I say that, by basing our valuation for actual organic impurity on the points already mentioned, we can easily give to non-scientific persons a fair expression of the actual condition of the water in all ordinary cases. If analysts generally would agree to adopt the scale I am about to submit, they would thereby only be giving a generally intelligible expression to their figures, *quoad* the *actually present contamination*, and would not be in any way bound to desert the opinions they may hold as regards the value of other points of condemnation, involved in chlorides, nitrates, phosphates, or physical and microscopic indications, which might always be called in to supplement or modify the ideas of impurity gained from the scale in special cases. Having thus shown that the adoption of the scale I propose does not interfere with any notions other than those well established, and does not bind any man to blindly condemn or approve of a water, but simply provides a means popularly expressing the actually present organic impurity, I proceed to detail it.

The valuations already proposed by Mr. Wigner for "oxygen consumed in 4 hours," has in my hands answered all its purposes; but those for "ammonia, albuminoid ammonia, and oxygen consumed in 15 minutes," have undergone some modification. The figure for "ammonia" given is 1 for every ·005 per gallon. This is not sufficiently low for town waters. When water otherwise in fair condition is kept in a cistern which is allowed to become foul or is directly communicated by a waste pipe with the drains, the first indication of such a case is an increase in the free ammonia. On the other hand we meet with deep artesian waters, which, although themselves pure in other respects, are highly charged with ammonia—most probably from decomposition of the nitrates in the pipes of the well—and if we have too low a factor we may fall into error. But such cases are so self evident when compared with the other results, that no analyst of experience would give any weight to such an isolated indication, and, it therefore becomes more important to detect the former case than to over-estimate the latter. I have, therefore, decided that Mr. Wigner's last suggestion is more nearly correct, and I have finally adopted as a divisor ·0015 if per gallon, or ·02 if per million.

Taking next the case of albuminoid ammonia, I think that Mr. Wigner's divisor was a little too high. It is admitted by all chemists, that where a water exceeds ·10 per million in this indication it should be commenced to be looked upon with disfavour, and I, therefore, consider that the standard should take effect from that point, and the doubling of the figures be felt after touching this line. Actuated by this consideration I make the divisor for albuminoid ammonia ·0007 if per gallon or ·01 if per million. This is all the more necessary, seeing that, working by the method recommended by the Council of the Society, the yield of albuminoid ammonia, although more regular for comparative purposes, is not so great as when the amount of dilution on adding the alkaline permanganate is less.

Now, with regard to the "oxygen consumed in 15 minutes," which was put by Mr. Wigner at ·002=1 originally for 2 minutes, and then the same figure suggested for 15 minutes. I find by experience, and after applying the scale to upwards of 300 samples of good water, that in such an article, even when the waters are "upland peaty," and so acting powerfully on the permanganate, the proportion between the oxygen consumed in 15 minutes and that in 4 hours is almost invariably nearly that of 1 to 2. When, however, any animal matter—such as sewage, is added, the proportion of 15 minutes oxygen rises and becomes more nearly 1 to 1·5. It is, therefore, clear that the valuation for 15 minutes should be slightly higher than for 4 hours, but not to so great an extent, because if you have such a low divisor as ·002, then you infallibly condemn a possibly innocent peaty water. By actual experience with the scale, I have found that by using the figure ·004=1 we get a far more generally applicable expression, and one which does not bring any otherwise pure peaty water into the dangerous class, while it still strongly points out the waters contaminated with animal matter or nitrites.

Lastly, with regard to the actual expression of the result of the application of the scale, I think that to deal with whole numbers gives an exaggerated idea to the non-chemical public. A man would naturally exclaim:—"Dear me, here is a water having an impurity valuation attached to it of 25 degrees, and yet the analyst calls it first-class!" I therefore propose to divide the total valuation by 100, so that it shall be finally expressed in decimals, and only when the article is very bad indeed should it come into full numbers.

Taking then my whole proposal, it stands as follows:—

GRAINS PER GALLON.

Ammonia	each	·0015	= 1.
Albuminoid Ammonia	„	·0007	= 1.
Oxygen consumed in 15 minutes	„	·004	= 1.
Oxygen consumed in 4 hours	„	·010	= 1.

PARTS PER MILLION.

Ammonia	each	·02	= 1.
Albuminoid Ammonia	„	·01	= 1.
Oxygen in 15 minutes	„	·057	= 1.
Oxygen in 4 hours	„	·143	= 1.

When any number exceeds 10, then all over 10 is to be doubled and added to the original number, and the total valuation is to be divided by 100 and noted as "comparative degree of organic impurity." Then, *supposing no other consideration intervenes to modify the analyst's opinion of the sample*, I propose that the following limits should be observed:—

1st Class Water	*up to* ·25 degree.
2nd " "	*up to* ·40 "
Undrinkable Water	*over* ·40 "

Taking now the practical application of this scale to London waters, I find that, as the results of repeated examination of water from the mains on the South side during last year, and applying the scales, we get the following figures:—

AVERAGE ANALYSES FOR JANUARY, 1882.

Ammonia	·001	·383 comparative degree of organic impurity.
Albuminoid Ammonia	·005	
Oxygen in 15 minutes	·059	
Oxygen in 4 hours	·075	

AVERAGE ANALYSES FOR FEBRUARY, 1882.

Ammonia	·000	·215 comparative degree of organic impurity.
Albuminoid Ammonia	·005	
Oxygen in 15 minutes	·033	
Oxygen in 4 hours	·065	

AVERAGE ANALYSES FOR MARCH, 1882.

Ammonia	·000	184 comparative degree of organic impurity.
Albuminoid Ammonia	·005	
Oxygen in 15 minutes	·026	
Oxygen in 4 hours	·049	

AVERAGE ANALYSES FOR APRIL, 1882.

Ammonia	·000	- 226 comparative degree of organic impurity.
Albuminoid Ammonia	005	
Oxygen in 15 minutes	038	
Oxygen in 4 hours	061	

AVERAGE ANALYSES FOR MAY, 1882.

Ammonia	000	= ·253 comparative degree of organic impurity.
Albuminoid Ammonia	·007	
Oxygen in 15 minutes	·037	
Oxygen in 4 hours	·061	

AVERAGE ANALYSES FOR JUNE, 1882.

Ammonia	·000	= ·247 comparative degree of organic impurity.
Albuminoid Ammonia	·007	
Oxygen in 15 minutes	·034	
Oxygen in 4 hours	·062	

AVERAGE ANALYSES FOR JULY, 1882.

Ammonia	·000	= ·287 comparative degree of organic impurity.
Albuminoid Ammonia	·007	
Oxygen in 15 minutes	·040	
Oxygen in 4 hours	·087	

AVERAGE ANALYSES FOR AUGUST, 1882.

Ammonia	·000	·225 comparative degree of organic impurity.
Albuminoid Ammonia	·005	
Oxygen in 15 minutes	·038	
Oxygen in 4 hours	·060	

AVERAGE ANALYSES FOR SEPTEMBER, 1882.

Ammonia	·000	= ·177 comparative degree of organic impurity.
Albuminoid Ammonia	·004	
Oxygen in 15 minutes	·028	
Oxygen in 4 hours	·050	

AVERAGE ANALYSES FOR OCTOBER, 1882.

Ammonia	·000	= ·185 comparative degree of organic impurity.
Albuminoid Ammonia	·005	
Oxygen in 15 minutes	·026	
Oxygen in 4 hours	·050	

AVERAGE ANALYSES FOR NOVEMBER, 1882.

Ammonia	·001	= ·663 comparative degree of organic impurity.
Albuminoid Ammonia	·011	
Oxygen in 15 minutes	·064	
Oxygen in 4 hours	·105	

AVERAGE ANALYSES FOR DECEMBER, 1882.

Ammonia	·001	= ·407 comparative degree of organic impurity.
Albuminoid Ammonia	·007	
Oxygen in 15 minutes	·054	
Oxygen in 4 hours	·095	

Thus we see that for 8 months in the year, the water supplied to the South of London, on the particular days it was examined was first-class, during July it was just over first-class, while during the two winter months of December and January, it was decidedly second-class, and on certain dates in November it was undrinkable.

Next let me take the case of a violent typhoid outbreak that happened last year at a popular resort, the name of which I do not give, preferring not to perpetuate the injury to the residents already done. This water supply is usually very excellent, but slightly peaty in character. Before the outbreak it was in its normal state which averaged as follows :—

Ammuonia	·000	= ·192 comparative degree of organic impurity.
Albuminoid Ammonia	·003	
Oxygen in 15 minutes	·034	
Oxygen in 4 hours	·064	

and its natural average varies according to the influx of peaty water up as high, during certain months as 25 degrees, but never beyond that point. The first appearance of impurity came thus :—

Ammonia	·003	·53 comparative degree of organic impurity.
Albuminoid Ammonia	·006	
Oxygen in 15 minutes	·068	
Oxygen in 4 hours	·115	

and within a very short time remours of typhoid began to be heard. Close upon this result I obtained :—

Ammonia	·003	·837 comparative degree of organic impurity.
Albuminoid Ammonia	·010	
Oxygen in 15 minutes	·086	
Oxygen in 4 hours	·137	

The epidemic then began to extend and assume the most severe character, and the local authorities being alarmed commenced examining the water system at various points, and sent a large number of samples. The nobleman who holds most of the ground from which the supplies are drawn also entered the field, and likewise submitted samples from various points. Among these during this time I find the following:—

Ammonia	·002	= ·120 comparative degree of organic impurity.
Albuminoid Ammonia	·007	
Oxygen in 15 minutes	·150	
Oxygen in 4 hours	·266	
Ammonia	·001	= ·135 comparative degree of organic impurity.
Albuminoid Ammonia	·008	
Oxygen consumed in 15 minutes	·153	
Oxygen consumed in 4 hours	·266	
Ammonia	·001	= ·160 comparative degree of organic impurity.
Albuminoid Ammonia	·010	
Oxygen in 15 minutes	·169	
Oxygen in 4 hours	·294	

By a continued process of narrowing down, it was found that the impurity came from one particular tributary stream, and at last it was I understand found that somebody had laid down some drains which drew the impurities from a field on which he had placed some large heaps of dung and other refuse matters to wait for the manuring of the fields. The matter was altered and the next set of analyses showed successively

Ammonia	·000	= ·53 comparative degree of organic impurity.
Albuminoid Ammonia	·008	
Oxygen consumed in 15 minutes	·075	
Oxygen consumed in 4 hours	·126	
Ammonia	·000	= ·378 comparative degree of organic impurity.
Albuminoid Ammonia	·003	
Oxygen consumed in 15 minutes	·051	
Oxygen consumed in 4 hours	·103	

No fresh cases occurred and the epidemic having died out, the last set of samples gave

Ammonia	·000	= ·203 comparative degree of organic impurity.
Albuminoid Ammonia	·005	
Oxygen consumed in 15 minutes	·036	
Oxygen consumed in 4 hours	·070	

Here then we have a striking instance of the use of the scale for detecting actually *fresh* and *present* organic impurity. We also see that judging from albuminoid ammonia only, the result could never have been arrived at, and that, even in peaty waters, when we take a scale based upon all the four considerations, we come to the truth. It is especially to be noted that the first danger signal came in the appearance of free ammonia and the increase in oxygen consumed, and more especially in the incresed ratio of the 15 minutes to the 4 hours, which being naturally about 1 to 2 became reduced to about 1 to 1·7, and consequently at once became prominent in the valuation.

Is it not reasonable to suppose that at first we got the urea and more soluble portions which acted by giving ammonia and increased rapidity of action on the permanganate, and then afterwards when decomposition began to affect the mass of dung we got it in the increase of both albuminoid ammonia and oxygen consumed? In conclusion, I submit these results and suggestions in the earnest hope of aiding the unanimity of analysts on the result of water analysis, and bringing I hope the whole question so ably commenced by our President nearer a practical solution. I am satisfied that some day we will all come to an agreement on some such basis, and I hope that time is not far distant, if I can only induce my colleagues earnestly to put their minds to the matter.

ON THE ACTION OF CERTAIN METALS UPON OILS.

Some time since Chevreul, the distinguished investigator of the fats and oils studied the effect produced upon the drying oils by different metals. He found that under certain circumstances metals exerted an influence upon the oxidation of the oils; for example, linseed oil when spread upon a sheet of lead dried immediately.

A. Livache believed that the metals would act more energetically if in the fine state of division in which they are obtained by precipitation from solution, instead of using only surfaces of sheets of metal. His experiments, which are exceedingly interesting, were published in *Comptes Rendus*, xcvi., 260.

Livache tried the effect of tin, copper and lead on the oils, but only the last name exerted any considerable action. The lead employed in the experiments was obtained by precipitation with stripes of zinc from a solution of a lead salt; it was quickly washed with water, then with alcohol and ether, and finally dried *in vacuo*. If this lead is moistened with a certain quantity of oil and then exposed to the air, in a short time an increase in weight is observed, and the more drying the oil the greater this increase. When raw linseed oil is treated in this way, the increase of weight attained its maximum in thirty-six hours, while the same oil, if merely exposed to the air alone, requires several months to reach this state. A solid but elastic substance is formed like boiled linseed oil dried in the air.

Experiments made with different oils show that the increase in weight is nearly the same as that of their fatty acids when exposed to the air for a few months.

Name of oil treated with precipitated lead.	Increase of weight in oil.		Increase of weight of fatty acid.
	In 2 days.	In 8 days.	In 8 months.
Linseed	14·9 per ct.	—	11·0
Walnut	7·9 ,,	—	6·0
Cloves	6·8 ,,	—	3·7
Cottonseed	5·9 ,,	—	0·8
Beech Nut	4·3 ,,	—	2·6
Rape	0·0 ,,	2·9	2·6
Sesame	0·0 ,,	2·4	2·0
Peanut	0·0 ,,	1·8	1·3
Olive Oil	0·0 ,,	1·7	0·7

Cottonseed oil was the only drying oil that showed a marked exception; the fatty acid from it exhibited a very slight increase in weight. This is probably the reason why this oil can play a double role, as a drying oil and as a non-drying oil, for it is used to adulterate linseed oil on the one hand and olive oil on the other.

Contact with precipitated lead, then, imparts to oil the property of absorbing oxygen rapidly. In his study of the oxidation of oil, Cloez has shown that it was always attended wite the total disappearance of the glycerine, and in Livache's experiments it was noticed that the glycerine was modified by the precipitated lead. If glycerine is mixed with precipitated lead in a tight bottle free from air, the lead soon vanishes, being oxidised at the expense of a portion of the glycerine, and then dissolved in it.

The facts above stated indicate that a rapidly drying oil can be obtained by simply treating linseed oil for some time with red lead or litharge, although the product thus obtained always remains greasy and does not dry as good and quick as boiled linseed oil.

In the arts advantage may be taken of this action of lead towards drying oils, as for example to prove the presence of cottonseed oil in linseed oil as well as in olive oil. Probably boiling may be dispensed with by substituting mere contact of the oil with precipitated lead or solutions of lead and strips of zinc on which the lead may be deposited in a fine state of division. Oils prepared in this way are always of a lighter color and retain a greater degree of fluidity. Perhaps the bad smell of boiling oils and the great danger of their taking fire in the operation can be avoided by this treatment.—*Oil, Paint and Drug Reporter.*

REFINING SHELLAC.

Ordinary commercial shellac, it is well known, when treated with alcohol does not furnish a clear solution, but always produces a more or less turbid, yellowish solution, which, when warmed, clears itself by forming a brown solution and throwing down a greyish-yellow sediment. Also, by filtration through good thick filter paper, a perfectly clear solution can be obtained, but this succeeds only when there is about ten per cent. of shellac in the solution, and not in working on large quantities. Of course, there is no difficulty in subsequently concentrating the thin solution by evaporating the excess of alcohol, but the filtration of large quantities is attended with loss of time and material, as well as other difficulties, for it is not easy to make the filters tight enough to prevent loss of alcohol, and the filter paper has to be frequently changed.

Dr. Peetz proposed to add finely pulverized chalk or carbonate of magnesia, which would carry down the light particles of wax that make the solution turbid. This may answer for small quantities, and where the cost ot manipulation is not taken into account, but is absolutely useless for large quantities.

Shellac is not a pure natural product, but is prepared from stick lac by melting, straining, and washing. Both in stick and shell lac there is a substance which some chemists call wax and others fat, that will not dissolve in alcohol and ether, but is soluble in benzine, naphtha, &c. Dr. Peetz adds to three parts of shellac solution one part of petroleum ether and shakes well. After standing quietly for a few minutes the liquid forms two layers; the upper light brown one is petroleum ether containing the dissolved fat or wax, while below is a clear yellowish-brown solution of shellac to which only a little naphtha adheres. On removing the upper layer and allowing it to evaporate spontaneously, a white residue is obtained consisting of the fat that was in the solution. This fat can be saponified with caustic alkali, but is not dissolved by carbonated alkali, and on this property depends the new process for refining of shellac.

Edgar Andes, of Vienna, has been experimenting upon the best methods of refining shellac. and communicates his results to *Neuste Erfindung.* Passing by the details of his experiments as given in the original, we give his final results. He says: "I have come to the conclusion that for the preparation of a perfectly soluble shellac that shall retain its other quantities unchanged, ten pounds of shellac should be treated with three pounds of soda (carbonate of soda) dissolved in ninety pounds of water.

"The operation is conducted as follows: The water is heated to boiling in a suitable kettle, the soda added next, and when that is dissolved the shellac is put in slowly, waiting for the first portion to dissolve before adding more. The liquid has a pink color and the well-known agreeable odor of shellac. It is turbid from the small amount of fat in it. After all the shellac is dissolved, the solution is boiled a few minutes longer, and the kettle covered with a tight-fitting wooden lid, which is luted on with clay, so that no air can enter. It is then allowed to cool slowly, and when the cover is at length removed, a thin cake of fat will be found floating on the liquor.

"This is removed and the liquid strained through linen. The shellac is then precipitated with dilute sulphuric acid added drop by drop. The yellow shellac is washed until it is no longer acid. The well pressed cake is put in boiling water, when it becomes softened, so that it can be worked by the hands into rods, strings, or rolls, which are next put in cold water containing glycerine, so that it will harden quickly, and then dried.

"The hot, soft shellac must be squeezed, wrung, and pressed to remove all the water. The refined shellac has a silver white brilliant surface, is yellowish-brown within, and must be perfectly dry, so as to dissolve without residue in alcohol." The presence of water in alcoholic solutions of any resin makes it turbid and milky.—*Scientific American.*

VINEGAR ADULTERATION IN AMERICA.

THE following Act, which was approved on the 17th March, 1880, is that which regulates the sale of vinegar in Boston, Mass. :—

An Act to regulate the Sale of Vinegar.

Be it enacted, &c., as follows:

Sect. 1. Every person who shall manufacture for sale or who shall offer or expose for sale, as cider-vinegar, any vinegar not the legitimate product of pure apple-juice, known as apple-cider, and not made *exclusively* of said apple-cider, but into which any foreign substances, ingredients, drugs or acids have been introduced, as shall appear by proper tests, shall for each such offence be punished by a fine of not less than fifty nor more than one hundred dollars.

Sect. 2. Every person who shall manufacture for sale, or who shall offer or expose for sale, any vinegar found upon proper tests to contain any preparation of lead, copper, sulphuric acid or other ingredient injurious to health, shall for each such offence be punished by a fine of not less than one hundred dollars.

Sect. 3. The mayor and aldermen of cities shall, and the selectmen of towns may, annually appoint one or more persons to be inspectors of vinegar for their respective places, who shall before entering upon their duties be sworn to the faithful discharge of the same.

Sect. 4. This Act shall take effect upon its passage.

The Report of Dr. B. F. Davenport, inspector of vinegar for the year ending 31st March last, to the Mayor and City Council of Boston, enters so fully into the question of the adulteration of vinegar that we print it in its entirety for the benefit of our readers :—

"I have the honor to submit the following report, as Inspector of Vinegar for the city, for the year ending March 31, 1883.

"The very defectively drawn statute under which I am called upon to act forbids, under penalties, the sale of any vinegar containing anything injurious to health, or as cider-vinegar of any vinegar not the legitimate product of pure apple-juice, known as apple-cider and not made exclusively of said apple-cider. It does not, however, provide any standards as to what shall be considered as a vinegar in general, or as a pure apple-cider in particular.

"It became, therefore, my earliest duty to determine these necessary points, as, without them, evidently, no one could be accused of having offended the statute. I first sought to determine how sour or acid any liquor must be, if made of any of the material of which vinegar may be made, to entitle it to be called a vinegar; in short, where was the line to be drawn between a simply *soured* liquor and a vinegar properly so called. There happens to be one leading American authority upon this point; and that one is all-sufficient, as being the very highest possible. It is the United States Pharmacopœia. This it is that gives the minimum standard recognised by the United States Government in its revenue tariff, by the Commissary-General of Subsistence of the United States War Department, and by the Massachusetts, New York, and New Jersey Adulteration of Food and Drug Acts. According to the United States Pharmacopœia, 'vinegar is an impure dilute acetic acid prepared by fermentation,' of which 'one ounce is neutralised by *not less* than thirty-five grains of bicarbonate of potassium,' which is an acid strength equivalent to the presence of 4·6 per cent. by weight of an absolutely pure acetic or vinegar acid. According to the *National Dispensatory*, a commentary by Professors Stillé and Maisch, upon the U.S. Pharmacopœia 'it should contain between 5 and 6 per cent. of acetic acid.'

"The well-known authority upon such subjects, Dr. Edward R. Squibbs, of New York, when speaking of this very subject in the last number (No. viii., p. 254) of his journal, *An Ephemeris*, says 'This is about the strength for *ordinary* table vinegar, though it might be stronger with advantage.' And upon page 266, after speaking of dilute acetic acid as containing a little more than 6 per cent. of absolute acetic acid, he says 'this preparation is just the strength that *very good* vinegar should be, not only for medicinal uses, but for all family uses as a most wholesome condiment.' And he says of such: 'This vinegar has been used for many years in the families of the writer and many friends, and the experience with it for family use is very favorable.'

"In other countries the standard pharmacopical requirements are about the same, or even higher. In Great Britain 5·4 per cent. of the absolute acid is required in the Pharmacopœia, while the standard or 'proof vinegar' of the excise contains about 6 per cent. of the acid. In Russia the Pharmacopœia requires at least 5 per cent.; in Belgium 5·6; in Germany and Austria 6, and in France 8 to 9 per cent. The wine-vinegar, made in casks at Orleans, France, contains sometimes as much as 10 per cent. of absolute acetic acid.

"In view of the above I also came to the same conclusion as the *South Kensington Museum Handbook*, by Prof. A. H. Church, published for the Committee of Council on Education, for visitors to that museum of food-products, that 'good vinegar contains 5 per cent. of real or glacial acetic acid' at the least; while Dr. A. H. Hassall, in his celebrated work upon *Food, its Adulteration, etc.*, last edition, that of 1876, page 635, says: 'It is generally stated that *good vinegars*, such as all Nos. 24 ought to be, should contain 5 per cent. of anhydrous, which equals 5·88 per cent. of absolute pure glacial acetic acid.

‘Having thus determined what in general could be called a vinegar, I sought to determine what were the natural limits of variability in composition to be found in strictly pure apple-cider vinegar such as is required in the statute. In furtherance of this object I sought to obtain as many samples as possible of cider-vinegar of all qualities, but of *known* purity, by attending and addressing upon this subject the Convention of New England Cider and Vinegar Makers, who, to the number of about four hundred, met at the New England Manufacturers' and Mechanics' Institute, upon the 1st and 2nd of November, 1882, and also the New England Grocer's Association, at their regular monthly meetings, held in this city. I strongly urged them to aid on the object, which they all claimed to wish to further, by sending me as many samples as possible. For this object, I was presented by Aaron D. Weld, Esq., proprietor of the well-known Weld's Farm, in West Roxbury, with a series of samples of the last fourteen successive annual pressings from his apple-orchard, I visiting his place, and seeing for myself the exact method of manufacture.

“ All the various samples of cider-vinegar of known quality which I was thus able to obtain I examined, and never found one which was of the age of about two years and upwards (an age agreed upon by all as at least necessary for the development of a good vinegar by the cask method), which had an acidity equivalent to the presence of less than 6 per cent. by weight, of absolute acetic acid. From this as the minimum, I found samples to range as high as about 9 per cent. of this acid. No one of these samples, also, upon evaporation over boiling water to a constant weight, yielded a fixed residue of 1·8 per cent.

“ The following authorities give these mentioned percentages of acid for vinegars: Twinging's *Handbook to the Food Department of the Parker Museum of Hygiene*, for ordinary table vinegar to 6 per cent.; Bloxham, Miller, Ure, and Felker, in their works on chemistry, each 5 per cent.; Kensington 6·8 per cent.; Hoffmann 4·5 to 6 per cent.; Elsner, for good, 6 to 8 per cent.; Fowne 5 to 15 per cent. In the case of spirit or white-wine vinegar, Wagner puts it at 6 to 8 per cent.; Allen at 8 to 10 per cent.; Souberain at 8 to 9 per cent.; Elsner 6 to 12 per cent.; König at 5 to 12 per cent.; Guibourt, Dorvault, and Chevallier each at 7 to 9 per cent.; Dietzsch at 7 to 11·76 per cent.; Post at 6 to 9 per cent.; and Roscoe and Schorlemmer, for the strongest vinegar possible, at 10 to 15 per cent. Most of these authorities also place the evaporated extract for cider-vinegar at not below 1·5 per cent. in weight.

“ In view of the above fact, and to make sure that not even the poorest *straight* cider-vinegar, made from *whole* apple-juice, could possibly be condemned, I recommended to the State Board of Health, Lunacy, and Charity, that they, as authorised under the late act relating to the adulteration of food and drugs, should fix the standard for vinegar at an acidity equivalent to the presence of not less than 5 per cent., by weight, of absolute acetic acid, and for cider-vinegar, a fixed residue at 212° F. of not less than 1·5 per cent. It was my proposed standards, thus obtained and recommended, that the New York State Board of Health lately resolved to adopt for that State.

“ Having informed myself, through my own personal researches, and familiarised myself with all the literature of importance upon the subject of vinegar which has been published in England, France, and Germany, and which I have collected into my private library, and thus knowing what vinegar in general, and cider-vinegar in particular, ought to be, I have canvassed this city to ascertain what it was as actually offered for sale in this the principal market of New England.

"There is a popular demand for only two classes of vinegars—a white or uncolored, and a colored vinegar. The first, from whatever it may be made, being called white-wine vinegar, and the other, likewise, cider-vinegar—the presence of a little burnt-sugar color, and may be a little more or less of flavouring with *soured* cider, being oftentimes the only *real* difference between them. The white-wine vinegar itself is made principally from vaporized alcohol, high wines, whiskey, or glucose, or from diluted acetic acid itself, from whatever source obtained, inclusive even of the pyroligneous acid.

"It is in the colored, or so-called cider-vinegars, that the most numerous violations of the statute are to be found. The principal adulterated varieties of cider-vinegar are the so-called fruit vinegar—a glucose vinegar colored and flavored up to imitate cider-vinegar, and then sold as such; other varieties of white-wine vinegars, 'fixed' in like manner, and simple cider-vinegar, more or less diluted with water by the cider having had water added either during or after the expression of the apple-juice. All of these various mixtures are quite readily distinguishable to the personal satisfaction of the expert examiner; but, under the present very ill-drawn statute, it would be quite useless to attempt to prove some of them before an average jury. Hoping to remedy these defects in the statute, I appeared before a committee of the present Legislature, who gave a hearing upon this subject to the gentleman chiefly instrumental in having the present statute itself passed, The committee, however, reported inexpedient to legislate.

"I have examined between 250 and 300 samples of vinegars collected from manufacturers and grocers of all classes, spread over all sections of the city, in regard to their strength, quality and purity, as regards their strength in acetic acid, with the following results:—

"2·4 per cent. of the samples contained 2 to 2·5 per cent. of the acid; 3·2 per cent. had 2·5 to 3 per cent.; 15·2 per cent. had 3 to 3·5 per cent.; 18·8 per cent. had 3·5 to 4 per cent., 25·6 per cent. had 4 to 4·5 per cent.; 12 per cent, had 4·5 to 5 per cent.; 10·8 per cent. had 5 to 5·5 per cent., 8·2 per cent. had 5·5 to 6 per cent.; 2·8 per cent. had 6 to 6·5 per cent.; 2·4 per cent. had 6·5 to 7 per cent.; 1·2 per cent. had 7 to 7·5 per cent.; 1·6 per cent. had 7·5 to 8 per cent.; 0·4 per cent. had 8 to 8·5 per cent., and 0·4 per cent. had 8·5 to 9 per cent. of acetic acid. Thus, 77·2 per cent. of the samples fell below the at least 5 per cent. of acid proper to a straight, whole, undiluted cider-vinegar, while only 22·8 per cent. of them reached or surpassed it. Evidently there is here need enough for an inspection of the vinegars sold in this market.

"No vinegar, however, was found containing free mineral acids, a dangerous amount of metallic impurity, or with much of any of the acrid vegetable substances that have at times been found in vinegars.

"So-called cider-vinegars ranged in acid strength all the way from 2·1 to 9 per cent. of acetic acid, and in respect to solid residues from 0·1 to 9·7 per cent.

"Only 22 per cent. of the samples did I find to be really good in regard to their strength, quality, and purity, while 13 per cent. were so *positively bad* beyond all question that, under the advice of Chief Justice Parmenter of the Municipal Court, and the Hon. Oliver Stevens, District Attorney, I sent them a copy of the following notice:—

"Mass. College of Pharmacy.
"Chemical Laboratory.

"City Inspector of Vinegar. Boston, Mass., 18 .

"Sir,—Under the advice of the District Attorney, you are hereby notified that upon
there was obtained for me by purchase at your place of business,
No. a sample of Vinegar, which does not conform in strength, quality or purity to the State Statutes relating to Vinegar, and that if such another sample is obtained of you, your case will then be reported to the District Attorney, to be proceeded with according to the law.

"Yours very respectfully,
"Dr. BENNETT F. DAVENPORT,
"Inspector of Vinegar for the City of Boston.

"Only the three worst samples, however, of each of the principal varieties of adulterated cider-vinegar were entered for trial in the courts to test the statute. These all three were taken up to the Superior Court. There one pleaded guilty, and paid his fine, one was defaulted on account of a doubt of his being the really responsible party, and the trial of the third is still pending. So far, however, as samples have since been obtained from those upon whom the above notice was served, they have in every instance proved to be of at least passable character, while some were even of a high grade. Thus it would seem that at least fair vinegar is obtainable when really desired, notwithstanding that, as I have been informed from quite a number of separate sources, there has been a very decided increased demand for warranted pure country-apple cider-vinegar during the last few months.

"The sum of 814·02 dollars, which has thus far been paid me since my appointment, in June last, as Inspector of Vinegar for the city, has proved an exceedingly inadequate return for the time and expense I have had upon the city's account. I have bought the samples at an average cost of five cents each, paid my collector thereof at the rate of two dollars a day, borne my own laboratory and office expenses, had about a week of my time used up in attending to the cases in court, and made, besides, about three hundred chemical examinations of samples, each of which involved as much time and labor as to make a milk analysis, such as the Milk Inspector has to pay his analyst ten dollars for each.

"If the city really desires to have the statute now executed in any proper manner, every seller of vinegar in the city should expect to be called upon to furnish the Inspector, at the least, one sample of vinegar during the year, and the manufacturers much oftener. These 3,000 samples, together with the wages of a properly responsible assistant to collect them, and to act as witness to the fact of sale, with the cost of chemical laboratory supplies, would cost me at the least 500 dollars during the year. The salary of 1.500 dollars, which was the one appropriated for my predecessor as Inspector, I consider to be a very moderate return for my personal services and expenses in the proper performance of the duties of my office in the laboratory and courts."

FOOD ADULTERATION IN FRANCE.

The following Analyses were made at the Paris Municipal Chemical Laboratory, during the month of April, 1883:—

Nature of the Samples Analysed.	Good.	Passable.	Bad		Totals.
			Not Injurious	Injurious	
Wines	101	97	381	29	608
Vinegars	2	1	—	—	3
Beers	10	1	1	—	12
Ciders	2	1	1	—	4
Alcohols and Liqueurs.	1	—	1	5	7
Syrups	1	—	—	—	1
Waters	3	3	1	7	14
Milks	22	110	94	—	226
Malt	1	—	—	—	1
Butters	10	—	14	—	24
Oils	2	1	8	—	11
Flours	5	—	3	—	8
Dough, Bread	6	—	2	—	8
Sweetmeats	1	—	3	2	6
Meats	1	—	1	—	2
Preserves	2	—	1	7	10
Salt, Pepper	2	—	11	—	13
Chicory, Coffee, Tea	–	—	—	—	—
Chocolates	8	—	10	—	18
Honeys	—	—	—	—	—
Confitures	1	—	4	—	5
Colouring Materials	6	1	—	2	9
Toys	—	—	—	9	9
Coloured Papers	1	1	—	3	5
Tins	6	—	—	4	10
Pharmaceutical Products	—	—	—	—	—
Perfumery	—	—	—	—	—
Various	3	—	3	24	30
TOTAL	197	216	539	92	1,044

DETECTION OF FUSEL IN COMMERCIAL ALCOHOL.

H. Marquardt dilutes 150 grms. of the alcohol to be examined with water so as to bring it to from 12 to 15 per cent. of actual alcohol. He shakes it up with 50 c.c. chloroform for 15 minutes and draws off the chloroform. This process is repeated three times. The chloroform extracts are mixed together and shaken up three times with an equal volume of water for fifteen minutes, in order to remove alcohol. The chloroform which now contains no alcohol, but all the fusel, is mixed with a solution of 5 grms. potassium bichromate in 30 grms. water and 2 grms. sulphuric acid, and heated for six hours to 85 deg. on the water-bath in a strong, well corked bottle, shaking frequently. When the oxidation is complete the contents of the flask and the washings are introduced into a distillation apparatus and distilled down to 20 c.c. To the residue about 80 c.c. of water are added and the mixture is again distilled down to 5 c.c. The distillate is mixed with barium carbonate, and digested for about 30 minutes in a reflux cohobator. The chloroform is distilled off, the residue is evaporated on the water-bath down to about 5 c.c., freed from the excess of barium carbonate by filtration, washed, and the filtrate is evaporated to dryness on the water-bath. The residue is dissolved with water and a few drops of nitric acid, so as to make up 100 c.c. In 50 c.c. the barium is determined, and in the other 50 c.c. the chlorine. The quantity of barium chloride corresponding to the chlorine is deducted from the total residue, and from the baryta of the rest the quantity of the fusel is calculated so that 2 mols. amylic alcohol represent 1 mol. baryta.—*Oil, Paint and Drug Reporter.*

MASSACHUSETTS STATE BOARD OF HEALTH.

In the Fourth Annual Report of the State Board of Health, of Massachusetts, lately issued, we find the following rules and regulations have been adopted to assist in the executions of the provisions of the Act relating to the adulteration of food and drugs, pursuant to chapter 263 of the Acts of 1882:—

First.—The State Board of Health, Lunacy and Charity shall appoint two analysts, to one of whom shall be chiefly assigned the duty of examining drugs, and to the other that of examining articles of food, each analyst to hold office during the pleasure of the Board.

Second.—It shall be the duty of the analysts so appointed to determine by proper examination and analysis whether articles of food and drugs manufactured for sale, offered for sale, or sold within this Common-wealth are adulterated within the meaning of chapter 263 of the acts and resolves passed by the General Court of Massachusetts in 1882, adulteration being defined as follows, viz., In the case of drugs: (1) If sold under or by a name recognized in the United States Pharmacopœia, it differs from the standard of strength, quality or purity laid down therein; (2) If when sold under or by a name not recognized in the United States Pharmacopœia, but which is found in some other pharmacopœia or other standard work on *materia medica*, it differs materially from the standard of strength, quality or purity laid down in such work; (3) If its strength or purity falls below the professed standard under which it is sold.

In the case of food: (1) If any substance or substances have been mixed with it so as to reduce, or lower, or injuriously affect its quality or strength: (2) If any inferior or cheaper substance or substances have been substituted wholly or in part for it: (3) If any valuable constituent has been wholly or in part abstracted from it: (4) If it is an imitation of, or is sold under the name of, another article: (5) If it consists wholly or in part of a diseased, decomposed, putrid or rotten animal or vegetable substance, whether manufactured or not, or in the case of milk, if it is the produce of a diseased animal: (6) If it is colored, coated, polished or powdered, whereby damage is concealed, or if it is made to appear better or of greater value than it really is: (7) If it contains any added poisonous ingredient, or any ingredient which may render it injurious to the health of a person consuming it.

Third.—The analysts shall procure, in the manner provided by the act, or in any legal and proper manner, and with reasonable diligence, drugs and articles of food included in the provisions of this act, for the purpose of examination and analysis, and shall report to the Board the result thereof, together with such suggestions as they may deem necessary to the efficient enforcement of the law.

Fourth.—They shall also report to the Board, from time to time, such articles, mixtures or compounds as, in their judgment, should be declared exempt from the provisions of the act; and they shall present to the Board lists of such articles or preparations, for publication by the Board, if the latter deems proper.

Fifth.—Should the result obtained by either analyst be questioned, the other analyst shall repeat the analysis, unless otherwise instructed by the Board, provided a sufficient sum to meet the expense of the analysis be deposited with the Health Officer, by any interested party feeling aggrieved, which sum will not be returned unless the second analysis fails to confirm the first in essential particulars.

Sixth.—Any appeal from the decision of an analyst shall be filed with the Health Officer, who shall report it, and any matter in controversy, to the Board, giving his judgment thereon, and the Board shall supervise and control the action of its officers in executing this act.

Seventh.—Where standards of strength, quality or purity are not fixed by the act, the analysts shall present to the Health Officer such standard as in their judgment should be fixed, and the Health Officer shall report the same to the Board for its action. The standards set by the British Society of Public Analysts will be followed as nearly as practicable, until otherwise ordered.

Eighth.—Whenever a drug or preparation, not described in a National Pharmacopœia, or other standard work on *materia medica*, shall be manufactured, offered for sale, or used in this State, the standard of such drug, and the standard and proportion of the ingredients of such preparation, and the range of variability from such standard or standards shall be ascertained by the analysts. who shall report the same through the Health Officer to the Board.

Ninth.—Each analyst shall procure all necessary and proper samples of drugs or articles of food for analysis, by tendering to the party manufacturing for sale, exposing for sale, offering for sale, or delivering on sale, the value of a necessary and proper sample, in each instance, and each analyst shall arrange his samples for analysis as he may may deem convenient and expedient.

Tenth.—Lists of the articles, mixtures or compounds, declared to be exempt, shall be published, and a copy of the same shall be sent to each board of health, each correspondent of the Health department, and to such other publications as may from time to time be determined.

Eleventh.—The analysts shall occupy such time in the performance of their respective duties as a reasonable compliance with the terms of the statute shall require, and shall be present one hour of each day, at such time of the day and at such place as shall be designated by the Committee on Health of the Board, to meet the convenience of interested parties and the public.

Twelfth.—The yearly compensation of the analyst of articles of food shall be 1,500 dollars; and that of the analyst of drugs shall be 1,000 dollars.

The following are the Analysts appointed:—Dr. Edward S. Wood, of the Harvard Medical School, analyst of articles of food; and Dr. Bennett F. Davenport, of the Massachusetts College of Pharmacy, analyst of drugs.

ANALYSTS' CERTIFICATES.

From a letter by a country correspondent of one of our trade contemporaries we take the following:—

What protection has either the public or the milk dealer in such cautiously and safely-worded certificates as the following?

"This is poor milk, but I have known milk from one cow much worse."

"This is very poor milk indeed compared to the average milk from 200 cows that I have seen milked myself."

"This is very poor milk, but not worse than would be given by half-starved or half-fed cows."

"This is extraordinary poor milk, but not worse than we might expect at this season of the year."

Certificates like these confound and paralyse the action of all local authorities who are working under the Act and depending upon them. They dumbfounder and make the milk-dealer panic-stricken by them, he knowing only too well the serious cost it will be to him. I honestly believe that certificates like these are only given to evade a certain amount of work, and the certificate is to evade responsibility.

We contend the Public Analyst has nothing on earth to do with either half-starved or half-few cows, or with good seasons. He is supposed to know nothing about the milk, who it belongs to, or where it comes from. His duty is to analyse the sample of milk submitted to him and give a certificate according to the standard that all Public Analysts are supposed to be ruled by, and it shall also contain all the component parts as shown by his analysis, and as he is directed to do so by Act of Parliament, and any other certificate but this one is an illegal document, and any Public Analyst who fails to do this is not doing his duty, and through this neglect he is depriving thousands of the practical benefits of the Sale of Food and Drugs Act, and giving encouragement to adulterators, and placing scores of milk dealers in jeopardy every day. If half-fed cows have anything to do with poor milk, the farmer would have no difficulty in proving this. He has the opportunity of doing so by having the cows milked in the presence of the inspector, and no matter how poor the milk might be, if it was what the cows give, the farmer would be right, he could not be prosecuted.

It is quite time certificates of this kind were put a stop to. They are unjust to every-one in the trade; they are a disgrace to an honourable profession, and bring it into contempt and disrepute.

REVIEW.

Chemical Percentage Tables and Laboratory Calculation.

By C. H. Ridsdale.

London: Crosby, Lockwood & Co., Stationers' Hall Court.

This book purports to be, what may be fairly called a chemical ready reckoner, and it cannot be better described than by taking the first sentence from the preface, which is: "The author's design in writing this little work is twofold—to enable the *student* of chemistry to understand the calculations of the laboratory, and to save the *chemist* from the greater part of the—to him—useless figuring," and the last sentence of the book itself, which is: "These examples will, it is hoped, prove sufficient to thoroughly ground the student in laboratory calculation."

Of course, in a work of this kind it is impossible to check all the figures, and therefore our opinion must be based upon statements which are capable of examination. Thus we find that, under "Coal," we are informed that in order to calculate the percentage of sulphur driven off during the coking process "generally one-half of the total percentage of the sulphur is considered near enough." And, again, under "Raw Ironstone:" "It is not customary in practice" * * * "to test ironstone, or indeed anything in the wet state, owing to the liability of the sample to dry, and thus impair the accuracy of the results."

It is hardly necessary to say that we dissent entirely from these two statements.

We must also refer to page 78, on which the calculation of carbon is directed to be made by means of vulgar fractions instead of decimals, which appears to us a retrogade step, and ought to have been entirely abolished from a work published in 1882.

CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

COPPER IN CEREALS.

To the Editor of "The Analyst."

Sir,—In the interesting *résumé* which Dr. Willoughby has given on page 83 of the current volume of the Analyst, of what is known respecting the presence of copper in cereals, he follows too implicitly the accounts given of researches in this direction by MM. Galippe and Armand Gautier—the latter in his recent interesting volume *Le Cuivre et le Plomb.*

After referring to Kuhlmann's papers on the subject, published in 1831, Dr. Willoughby says: "The subject seems to have been almost entirely neglected until last year." Surely Dr. Willoughby has not referred to English authorities, else he would have known that Drs. Odling and Dupré published in 1858 a valuable paper (Guy's Hosp. Rep. 1858, p. 103) on the subject, detailing elaborate analyses of bread and cereals made in order to determine the quantities of copper ordinarily met with in ordinary cereals, and articles of dietary made therefrom. Of forty samples of bread analysed by them, one only was found absolutely free from copper.

I am, &c.,
THOS. STEVENSON.

Guy's Hospital, London, S.E., May, 1883.

PARLIAMENTARY NEWS.

Substitutes for Butter.

Mr. Moore asked the President of the Board of Trade whether any steps had been taken by the Statistical Department of the Board of Trade, or the Board of Customs, to tabulate more accurately the different imports of butterine, oleomargarine, and other butter substitutes.

Mr. Courtney: My right hon. friend has asked me to answer this question. The proposal to raise a separate heading in the trade returns of butterine, and also for lard and other imitation cheese, has been considered by the Statistical Inquiry Committee, who have recommended, though not without doubt, that new headings should be raised for these articles. But as the officers of Customs have no means of verifying the importer's description in such cases, it was advised that a note should be added to the effect that there was no guarantee that the articles described as cheese and butter are not largely composed of mixtures. The Treasury are prepared to adopt this scheme as an experiment, and have embodied their views in a minute dealing with the whole report of that Committee. Before actually carrying out the various changes approved, we are awaiting the observations of the departments upon the Treasury minute.

LAW REPORTS.

In the Bristol Police Court, Mr. William Harris, wholesale dairyman, of Brislington and Narrow Wine Street, was lately summoned by Inspector May (8 division) for selling milk which on analysis was found to be adulterated with water. Mr. Clifton defended. Inspector May deposed that on April 12th he saw defendant drive across Bath Bridge. In his cart were several large cans of milk. Witness took two samples and told defendant that they were for analysis. One sample was of warm milk—that morning's milking—and the other, to use defendant's words, was cold, which witness took to mean the yield of the previous night. The sample of cold milk was found to be adulterated to the extent of 10 per cent. of added water. Witness here handed in the certificate of the City Analyst. Mr. Clifton, on behalf of the defendant, urged that the defendant sold the milk in precisely the same condition as he purchased it from the cow owner. The agreement between the parties was put in, and on it Mr. Clifton urged that the Act precluded a conviction. The bench were apparently not disposed to take the agreement as a warranty between the parties, but Mr. Clifton urged at length that it was so, and asked for a case if the magistrates held a contrary opinion. Defendant was examined. He said he had been 13 years in the trade, and during that time his milk had been sampled many times by the inspectors in various parts of the city, but had never been brought before the court previously. He could not account for the milk being adulterated to the extent of 10 per cent. of added water. It was sold to the inspector in the same condition as it had been received from the dairy farmer. Mr. J. Case having been called to prove the custom of the trade, the bench reserved their decision until the morning, at the request of Mr. Gore, who desired to consider the points raised by Mr. Clifton. The magistrates subsequently delivered judgment in the case as follows:—"Two legal points were raised in this case yesterday. First, that the agreement between the cowkeeper and the defendant for furnishing a supply of pure milk for six months was a 'written warranty' within the meaning of 25th sec. of the Food and Drugs Act 1875. Second, that it was necessary to prove the defendant was actuated by *mens rea*, *i.e.*, it should be proved to be knowingly sold as adulterated milk with intent to defraud. As to the first objection, we consider that the 27th section throws some light upon the kind of 'written warranty' required by the statute; that section makes provision for forging, misapplying, or giving a false warranty in writing—from which it must be intended not to apply to future supplies of goods, but a specific document containing words implying warranty given with the goods sold, and not a running contract. That is to say, it should be such a document of warranty that the vendor giving it should be punished for giving it if it were false. The contract in this case does not come up to the requirements stated by Baron Pollock in Rook *v.* Hooper, 3 Exchequer Division. His words are:—'In my opinion what is required by the statute is a writing expressly on the face of it that it is a warranty.' Secondly, is *mens rea* necessary? The case just quoted seems to show that it need not be proved that the defendant knowingly intended fraud. The words of the late Lord Chief Baron express that view. It has been decided expressly that it is sufficient to prove that the article sold was not that demanded. In the case of Fitzpatrick *v.* Kelly —Law Reports, 8, Queen's Bench—Justices Blackburn, Quain, and Archibald concurred in deciding that knowledge of the adulteration of the article need not be proved in order to convict the seller. We fine the defendant 10s., and 13s. 6d. costs." Mr. Clifton, who appeared for the defence, said he should ask for a case on the queston of warranty. He was surprised that the Bench dealt with the *mens rea*, for he abandoned that point. Mr. Gore said notice would be given in the usual way.

Milk Adulteration—Notice of Appeal:—

Harry Jones, of St. Michael's Hill, was summoned by Inspector Payne for selling to him on the 24th of February a pint and a-half of milk, which was not of the nature, substance, and quality of the article demanded. Mr. H. Reginald Wansbrough defended. Inspector Payne said he had divided the sample which he had obtained in the usual way, and that upon an analysis it was found to contain 10 per cent. of added water. In the course of cross-examination by Mr. Wansbrough he said that the defendant was a respectable tradesman, and that there was no hesitation on his part to supply him with the milk. Witness also admitted having received notice that the defendant intended to rely for his defence upon an agreement between himself and his farmer. Mr. Wansbrough, for the defence, put in the agreement, which provided that the farmer should supply 110 quarts of new milk daily from the 25th of March, 1882, to the 25th of March, 1883, and submitted that if he proved that this agreement had been entered into, and that the milk was sold by the defendant in the same state as it was when delivered to him by the farmer, he was entitled to a dismissal. Their Worships said they were of opinion that a written warranty was required under section 25 of the Food and Drugs Act, and that a written warranty must be delivered with each quantity of milk, and must specify that it should be pure milk. Mr. Wansbrough contended that such a construction could hardly be put upon the section because the agreement which he produced was an agreement to supply milk from day to day, from the 25th of March in one year to the 25th of March in the next. Defendant and his wife proved that the milk had been sold by them in precisely the same condition as it was when delivered to them by the farmer, and that nothing had been added to it whilst in their possession. The magistrates were still of opinion that the agreement was not such as to exonerate the defendant, and was not a warranty within the Act, and they therefore fined the defendant 20s. and costs. Mr. Wansbrough gave notice of appeal.

Mr. W. C. Young, F.I.C., F.C.S., one of the gas examiners for the Corporation of London, and Public Analyst for the districts of Poplar and Whitechapel, has been appointed consulting chemist to the Lee Conservancy Board.

RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

No. 1883	Name of Patentee.	Title of Patent.	Price.
3296	A. M. Clark	Sheet Lead Electrodes of Secondary Batteries	4d.
4275	W. V. Wilson	Manufacture of White Lead	2d.
4277	W. Lawrence	Treatment of Starchy Substances	8d.
4299	W. A. Barlow .. .	Accumulators or Secondary Batteries . ..	4d.
4302	J. G. Slatter . ..	Electric Lamps	4d.
4316	F. J. Cheesebrough ..	Secondary or Storage Batteries	6d.
4317	"	" " . .	6d
4344	R. Hammond & L. Goldenberg	Electric Lamp Carbons	2d.
4349	A. L. Nolf	Apparatus for producing Chloride Gas and Metallic Sodium from Sodium Chloride	6d.
4364	W. L. Wise..	Manufacture of Caustic Alkalies. ..	4d.
4367	W. Morgan Brown.. ..	Electric Lighting	6d.
4391	N. C. Cookson	Plates for Secondary Batteries	6d.
4396	A. Guye	Manufacture of certain Alloys of Gold	4d.
4405	A. J. Smith..	Manufacture of White Lead	6d.
4411	G. W. Von Nawrocki ..	Regenerating Peroxide of Manganese from the Residue obtained in Manufacture of Chlorine	2d.
4431	A. Watt	Secondary Voltaic Batteries	6d.
4461	J. W. Swan..	Dynamo Electric and Magneto Electric Machines	2d.
4487	J. Imray	Treatment of Phosphorites for the Manufacture of Manures..	4d.
4490	A. Khotinsky	Secondary or Accumulator Voltaic Batteries	4d.
4494	W. R. Lake..	Manufacture of Grape Sugar or Glucose	6d.
4511	J. D. Andrews	Apparatus for Storing, Measuring, and Regulating Electricity..	6d.
4525	F. M. Lyte	Secondary Batteries or Accumulators	4d.
4535	F. C. Glaser	Dynamo Electric Machines	10d.
4533	H. Symons	Purification of Gas	4d.
4561	F. C. Hills	Secondary Batteries or Accumulators	2d.

BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Practicien; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review.

THE ANALYST.

JULY, 1883.

SOCIETY OF PUBLIC ANALYSTS.

A **General Meeting** of this Society was held at Burlington House, on Wednesday, the 27th June, the President, Mr. Wigner, in the chair.

A ballot was taken, and the following declared duly elected: As Member—Dr. E. Lapper, Dublin. As Associate—Mr. C. A. Smith, Assistant to Mr. Hehner.

Mr. F. Thornley, Analytical Chemist, Ripon, was proposed as a Member, and will be balloted for at the next Meeting.

The following papers were then read and discussed:

"The Cause of a Peculiar Condition of some American Water Supplies," by C. R. Fletcher, Boston University, Mass.

"On a Sample of New Zealand Coal," by O. Hehner, F.C.S., &c.*

THE WORK DONE BY PUBLIC ANALYSTS UNDER THE SALE OF FOOD AND DRUGS ACT.

The usual forms have been sent out to nearly all Public Analysts requesting them to send a list of the samples they have examined during 1882 under the Act. Any Analyst who has not received a form, will, on application to the Secretaries of the Society, be supplied with the number he requires—*i.e.*, one for each district or town for which he acts.

It will much facilitate the labour of compilation if the returns are sent in to the Secretaries with as little delay as possible.

MILK ADULTERATION.

We wish to draw the special attention of our readers to a long report, printed on another page, of some proceedings taken at Manchester for alleged adulteration of milk. There are several statements of such an extraordinary character in the evidence given that we should have been glad to have noticed the case at length had it not been too late to allow us to do so.

NOTE ON THE USE OF BUTTER, MILK AND MAMMARY TISSUE IN THE MANUFACTURE OF BUTTERINE.

By C. Meymott Tidy, M.B., F.C.S., and G. W. Wigner, F.C.S., F.I.C.

Read before the Society of Public Analysts on 30th May, 1883.

Although the manufacture of butterine is very little understood in this country, it is not our purpose to enter at all into the details of the manufacture or to explain them in any way, but only to point out one or two facts which have come to our knowledge, and which have considerable chemical interest.

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* These Papers will be printed in our next number.—Ed. *Analyst.*

It has, hitherto, been a common error to suppose that it was impossible to mix butter with butterine, and this has no doubt led to mistakes in adulteration certificates from which we should apprehend that few Public Analysts have been free. It is quite likely that we ourselves have not been so.

The process of butterine manufacture is now conducted in such a way that there is no difficulty whatever in mixing any desired percentage of butter with the oleomargarine, which is the raw product—and it is just as easy to obtain a butterine containing 50 per cent. of true butter as one containing 1 per cent.

The manufacture of butterine appears to have been started about the year 1869, and the description of the process contained in the patent taken out then, appears to us to show clearly two things—first, that the inventor Mege, was, so to speak, ahead of his time, as regards what he saw as the future of his invention; and, secondly, that he had the idea in his mind of some chemical changes occurring in the fat under certain conditions, to which we will refer, but which, up to the present moment, have never been experimented upon by any chemists except ourselves.

The point to which we specially wish to draw attention now is the action of mammary tissue on fat. Mammary tissue in its crude form, may, of course, be taken to mean simply the chopped up udder of a cow, but it occurred to us, and the experiments show that we were right in our supposition, that this mammary tissue may also be contained in milk and in butter. We have made a good deal of inquiry on the subject, and as the result of this we are convinced that butterine is never made without the admixture of some portion, and usually a very considerable portion of milk and butter, or either one or other of these ingredients during the process.

The oleomargarine, pure and simple, which is the raw material of butterine, is simply purified suet, and as far as we have seen it is prepared with great care, melted at a low temperature so as to avoid any burning, which might produce a tallowy smell, and then sufficiently cooled to allow of the extraction by means of pressure of the excess of stearine which it contains. The more fluid part containing the larger proportion of oleine, is used for the subsequent manufacture of the butterine.

This raw material, *i.e.*, oleomargarine, is being made at the present time by a number of manufacturers in this country and abroad, and in fact the greater part of what is made here is being exported for further manipulation abroad, so as to make it into finished butterine, and export it again to this country as a more valuable article.

The next process is, to bring the fat into what is considered a different condition, and according to the experiments which we have recently tried, the process is certainly successful. It was proposed to treat the fat with mammary tissue for some few hours at animal heat, and we find that such a treatment as this does specifically alter the character of the fat, and that, as the result, an altered fat is obtained, which, even if it does not resemble butter, has at any rate been changed in character, so that it is not the pure oleomargarine fat that it was before.

We have repeatedly tried the experiment, and having taken pure animal fat, *i.e.*, melted suet, and digested it with the chopped up udder of a cow, for from three to six hours, we have found that a definite and marked chemical change in the composition of the fat was produced. This point appeared to us to open up a new field of inquiry, viz., to see whether it was really possible that the udder of a cow after death did contain any ferment or other substance analagous (we will say) to pancreatine or pepsine, but which, differing from them, might at any rate have some anomalous effect upon fat, so as to ensure its digestion, or so as to change it in any way.

Obviously it is desirable in carrying out an investigation of this kind that the udder of the cow with which the experiments are tried should be obtained from an animal which is in full lactation, and treated immediately after the cow has been killed. Up to the present we have not been able strictly to follow out this course, but we have obtained some certain results which are sufficient as serving to throw some light upon the matter, and we intend to carry it further. We took portions of the udders of cows, and extracted from them with dilute alcohol certain substances which proved on evaporation *in vacuo* to contain at least three different constituents. One of the three is a fatty body of a peculiar kind which needs further examination, and that examination must obviously present circumstances of special difficulty, which will be the more readily appreciated when we say that it appears, as far as we can see from preliminary experiments, to differ in several points both from oleomargarine and butter.

We also obtained two other products, but cannot report fully upon either of these at present. This much, however, has been found out, that one of them has a definite action upon fats, which action is of such a character that it changes the fat by altering its sp. gr., or actual density, and by producing a certain, although small amount of volatile fatty acids from the fat which previously contained nothing but insoluble fatty acids.

We have tried a number of experiments with mammary tissue, and with the extracts taken from the fresh udder; but, as far as we have gone, we find that practically there is no difference between the effect of the two.

Oleomargarine, or tallow, is in either case changed to a certain extent, and both soluble and volatile fatty acids are formed, instead of the insoluble fatty acids which were the only ones present before.

It follows from these experiments: first, that the chemical result which has been obtained so far is that the udder of the cow contains a certain substance or substances which are capable of acting upon fat, and which do by that action change its chemical composition. Secondly, that the same results can be produced by using an extract obtained from the udder of a cow.

But our experiments led us to go further even than this. Butter and milk both contain sensible proportions of mammary tissue in the shape of casts from the mammary glands, and they may, for aught we know to the contrary, and probably do, contain other matters which are not easily recognizable by microscopical examination, but which yet may be present in sufficient proportion to exert a definite physiological action, and from certain of our experiments we are inclined to think that this is the case.

Thus far, we are satisfied that both milk and butter do, to a certain limited extent, produce the same effect as we have already ascribed to mammary tissue. The action of milk, so far as we can judge at present is small, but it appears to result in the increase of the soluble fatty acids to a definite extent, which is quite sufficient to be capable of estimation. The action of butter is greater, perhaps, because it contains a larger proportion of substances derived from the mammæ of the cow, but it appears identical in character with the action of milk. This viewed from a chemical standpoint may mean solely that the milk when it passes into the udder of the cow does not contain butyric acid, but that butyric acid is generated entirely in the lacteal glands.

We have put this forward simply as a view, which may or may not be upheld by subsequent investigations, but still the probability of the fact being as we state is quite sufficient to justify its being mentioned.

CONTRIBUTION TO THE EXAMINATION OF THE FIXED OILS.

By William Fox, F.C.S.

Read before the Society of Public Analysts, on May 30th, 1883.

It is well known that animal and vegetable oils, on exposure to the atmosphere, become in time of a mucilaginous consistency, or in some cases are converted into solid masses. The length of time required to produce this change varies to a considerable extent with the different oils; linseed oil becomes quite solid in a few days, while olive oil only becomes slightly thick in several weeks. These two oils may be taken as the extremes in their power of absorbing oxygen, and it is to this property, a property possessed by (to some degree) all animal and vegetable oil, that this "drying" or "thickening" of the oil is due.

This property is explained in text-books by the statement that the oleic acid of the olive oil and the linoleic acid of the linseed oil possesses a great affinity for oxygen. This I find not to be the case: neither oleic nor linoleic acids when pure absorb any oxygen, as the following experiments will show:—

The acids were obtained by saponifying olive and linseed oils with caustic potash, decomposing with hydrochloric acid without using an excess, filtering and washing with water at 100° F. The acids were then washed into a separating flask and taken up with dry ether; this was repeated several times. The ether distilled off, the acids were obtained without having been heated over 100° F., thus reducing the risk of their absorbing oxygen during preparation.

Weighed quantities of the acids thus obtained were then sealed up in glass tubes, and maintained at a temperature of 220° F. in an oil bath for six days without absorbing any trace of oxygen, proving that the absorption of oxygen is not due to the oleic or linoleic acids present in the oils.

Thin strips of lead were suspended in the product obtained as described, without losing any weight, though the lead was in contact with the acids several days at 220° F.

While estimating the quantity of oxygen absorbed by olive oil, a great difference was noticed in several samples. This at first was supposed to be due to adulteration with other oils, until those samples which absorbed an abnormal quantity of oxygen were found to be rancid and to contain quantities of free acid. On heating these samples to 400° F., this free acid was expelled, and then the oil absorbed the same quantity of oxygen as those which were sweet and contained no free acid.

This I find to be the case with all the vegetable oils: the larger the amount of oxygen absorbed, the larger amount of free acid they contain.

It therefore follows that the absorption of oxygen does not depend on the oleic or linoleic acid, but on the products of the decomposition of these acids, other acids being formed which possess the power of absorbing oxygen and also of combining with metals or oxides of metals. Metals combine with these acids without giving off any hydrogen.

The action of the so-called driers—such as the oxides of iron, manganese, and lead, on being added to an oil appears to hasten the decomposition of the fatty acids, producing those acids having a tendency to absorb oxygen.

The insoluble fatty acids are lowered to a considerable extent by oxidation, the soluble acids being increased.

The quantity of a metal dissolved by an oil is not a measure of the free acid the oil contains, but proves whether the oil is one that will readily undergo decomposition. This is of importance in the examination of lubricating oils. Testing for and estimating the free acid in a lubricating oil is of no value as regards the liability of the oil to undergo decomposition, as the sample, if new, will be unlikely to contain free acid, though what it may do in time at present there is no means of showing.

This property of absorbing oxygen may be taken advantage of as to the liability of an oil to undergo decomposition, and thus affords valuable information as to the suitability of an oil to be used as a lubricant, its fitness to be used in the manufacture of varnishes and floor-cloth, and as a test as to the purity of an oil.

The following I find a good method for the examination of lubricating oils :—

About 1 gramme of the oil is sealed up in a glass tube having a capacity of about 100 c.c., with ·5 grammes of precipitated lead. The whole is then heated in an oil bath for several hours at 220° F. The amount of oxygen absorbed is then estimated ; this may be done by the decrease in the volume of the gas in the tube, or the remaining gas may be measured and the unabsorbed oxygen absorbed with pyrogallic acid and potash.

The less quantity of oxygen absorbed by the oil, treated in this manner, the better the oil for lubricating purposes. This method not only shows the presence of free acid, but also what the oil may be expected to do while being used in contact with metallic surfaces.

The only oils having no effect on metals and absorbing no oxygen, are properly prepared hydrocarbon oils. These oils far surpass all other oils as lubricants. Samples of mineral oils heated to 220° F. with precipitated lead absorbed no oxygen in 20 days ; vegetable or animal oil so treated became quite hard in a few days.

In the manufacture of varnishes and floor-cloth a great deal depends on the drying properties of linseed oil. This oil varies more than any other in its power of absorbing oxygen.

The following table will show the great difference in the power of absorbing oxygen possessed by a few of the more important fixed oils :—

C.C.'s of oxygen absorbed by 1 gramme of the oil.

Baltic Linseed Oil	191·
Black Sea " "	186·
Calcutta " "	126·
Bombay " "	130·
American " "	156·
Cotton Seed Oil (refined)	24·6
Rapeseed Oil (brown)	20·
Rapeseed Oil, Colza	17·6
Olive Oil (highest)	8·7
Olive Oil (lowest)	8·2

· These figures are the means of a great number of experiments on different samples, closely agreeing with each other except in the case of linseed oil.

The great difference between the Indian and Russian seed oils will be noticed; the latter are the oils used for varnishes and floor-cloth making. The Indian seed oil never becomes quite dry but always remains "tacky."

The cause of this difference in the drying properties of linseed oil is generally understood, and is so stated in text-books, to be due to the presence of albuminous matter. This statement is made, I imagine, owing to the fact that when linseed oil is heated rapidly to 400° F. an albuminous-looking matter separates. Oil made from seed grown in warm climates contains more of this substance than oil made from seed grown in cold climates, and the more of this so-called "albuminous matter" there may be contained in the oil, the lower the drying qualities of the oil. I have made experiments on oils containing large quantities of this substance, but have never been able to find a trace of nitrogen, either by combustion with soda lime, or by distillation to dryness with permanganate of potash.

I have separated, as well as possible, some of this substance from the oil, and from the results of two analyses it appears to be oleic acid—at least the hydrogen was too low for linoleic acid. It will be understood that, as linseed oil varies to such an extent, a test that will prove whether an oil is fit to be used for varnish and floor-cloth making, is of value to the manufacturer of these things.

The following method may be employed to this end:—

50 c.c. of the oil is heated in a beaker, over a Bunsen flame, to 500° F., 2·5 grammes powdered and dried oxide of iron (Fe_2O_3) is then added and the heating continued to 550° F., the burner is then withdrawn and the oil allowed to cool a little, then filtered through filter paper to remove any suspended oxide of iron. About ·2 grammes (rather less than more) of the oil so treated is sealed up in a tube and oxidized in the oil bath at 220° F. The oxidation will be complete in about four hours; the oxygen left unabsorbed is then estimated by means of pyrogallic acid and potash.

I use a conical shaped flask, having a capacity of 200 c.c. and fitted with an accurately ground stopper. The flask is weighed, and as the oil slowly filters 5 or 6 drops are received in the flask, and the flask again weighed gives the amount of oil being operated upon. If the stopper be smeared with a little burnt india-rubber, any escape of gas is impossible. At the end of four hours the stopper is withdrawn under water, the gas measured in a eudiometer and the remaining oxygen absorbed with pyrogallic acid and potash. From the data thus obtained the oxygen absorbed is calculated. Of course the usual precautions of gas analysis must be observed.

As first worked out by me, the oil was spread on a plate of glass, and the increase of weight owing to the absorption of oxygen, weighed. This method does not work satisfactorily and, from the small quantity operated upon, serious errors were liable to occur. By sealing up and measuring the oxygen, excellent results are obtained.

The difference between the amount of oxygen absorbed by olive and cotton oil is greater, I think, than any difference hitherto observed between these oils. The only test of any value for the purity of olive oil is the "ELAIDIN" test—though this test is far from being satisfactory, as all tests must be that depend so much on the operator's judgment. By estimating the quantity of oxygen absorbed, the purity of the oil may at once be proved. Under no circumstances have I found pure and sweet olive oil to absorb more than 9 c.c. of oxygen.

Taking this figure as representing pure olive oil and 24 as cotton oil, the quantity of the latter may be calculated thus:—

$$\frac{(A-9)\,100}{15} \text{ equals percentage of cotton oil.}$$

where A is the number of c.c. O absorbed by 1 gramme of the oil under examination.

Working in this manner, the following results were obtained:—

Olive oil containing 5 per cent. cotton oil absorbed 9·5 c.c. O, equal to 3·3 per cent. cotton oil.

Olive oil containing 10 per cent. cotton oil absorbed 10·4 c.c. O, equal to 9.3 per cent cotton oil.

With 20 per cent. cotton oil 12·3 c.c. O was absorbed, equal to 22 per cent. cotton oil.

Containing 25 per cent. cotton oil 13 c.c. O was absorbed, equal to 26·6 c.c. cotton oil.

If the oil under examination be at all rancid, it must first be heated to 400° F. before estimating the quantity of O the sample absorbs.

In concluding this paper, I regret not being able to more fully explain the changes which take place in the "drying" of the fixed oils. That the generally accepted idea is wrong there can be no doubt, and I hope before long to be able to throw more light on the subject.

Any investigation on oils must be carried out independently, as no text-books contain any information of value.

The subject is a very interesting one, and the ground for experiment and investigation unlimited.

That chemists have not paid more attention to the chemistry and properties of these complex class of compounds is singular, considering the large amount of capital, and the importance of the oil industry.

THE EMPLOYMENT OF HYDROGEN PEROXIDE IN CHEMICAL ANALYSIS.*

NOTWITHSTANDING that hydrogen peroxide has been known for a long time, and is daily used for a number of technical purposes, its employment in chemical analysis has hitherto remained in abeyance. This has probably been due to the loss of time involved in preparing it pure in the laboratory, and the impurity of its solutions hitherto brought into the market.

Carl Roth & Co., of Berlin, now prepare solutions of hydrogen peroxide in a state pure enough for analytical purposes, and the authors of this paper, Alex. Classen & O. Bauer, have employed it with success in several analytical determinations.

Hydrogen peroxide converts ammonium sulphide to sulphate and, what is the same thing, its solutions made alkaline with ammonia, oxidise sulphuretted hydrogen.

A number of metallic sulphides are very readily oxidised by an alkaline ammoniacal solution of hydrogen peroxide without any intermediate precipitation. This is the case with the sulphides of arsenic, copper, zinc, and thallium. In the case of tin sulphide, the oxide of the metal is precipitated, while the whole of the sulphur is oxidised to sulphuric acid. Mercury sulphide, which is hardly attacked by nitric acid, is very readily oxidised by hydrogen peroxide. A solution of cadmium sulphide forms a yellowish-white precipitate soluble in hydrochloric acid.

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*[Berichte der deutschen Chemischen Gesellschaft](), May 7, 1883.

Several metallic sulphides, the solutions of which are precipitated by ammonia, are decomposed by hydrogen peroxide into sulphuric acid and a hydroxide of the base, which precipitates, for instance, iron sulphide.

The authors believe that hydrogen peroxide will soon be generally employed in analytical operations, as a clean, handy, and energetic oxidising agent. Amongst other determinations which yielded good results may be mentioned the determination, in the presence of sulphuretted hydrogen, of hydrochloric, hydriodic, and hydrobromic acids.—*Chemist and Druggist.*

VOLUMETRIC ANALYSIS AND FAT-TESTING.

Karl Zulkowsky and Max Groger have thoroughly tested Haussmann's volumetric method of analysing fats, and have at the same time so improved and simplified the same that in their opinion the examination of a mixture of neutral fats and fat acids is easier than an examination of a mixture of caustic soda and sodium carbonate. Haussmann's method is based upon the fact that an alcoholic solution of a fat acid is immediately saponified on the addition of an alcoholic solution of caustic potash, whereas the saponification of a neutral fat can only be effected by protracted boiling. When, therefore, an alcoholic solution of fat acids and neutral fats, to which some phenolphthaleine has been added is titrated with caustic potash, the red colour disappears as long as any fat acid is present, and the solution does not attain a permanently red colour until all the fat acids are saponified. When the red colour has set in, an excess of caustic potash is added, and the whole boiled for half-an-hour to saponify all the neutral fats, and re-titrated, whereby the amount of caustic potash required to effect the saponification of the neutral fats is ascertained, and the quantity of caustic potash required for each titration represents the relative proportion of fat acids and neutral fats in the mixture operated on.

Not only is the method useful in ascertaining the relative proportions of fat acids and neutral fats in a given mixture, but it also serves for testing fats generally, as, for instance :—

1. For determining the equivalent of a fat, *i.e.*, the proportion saponifiable by an equivalent of caustic potash, or 1 litre of a normal solution of potash. The result obtained might, under circumstances, serve as a criterion as to the nature of the fat. The equivalent would, no doubt, in the case of butter-testing, indicate whether the butter was genuine or artificial.

2. For determining the amount of glycerine (theoretical yield) in fats in the most simple manner imaginable. When a neutral fat, or a mixture of a number of such fats, is saponified, the following reaction takes place :—

$$C_3H_5(OC_nH_2N—_1O)_3+3KOH=C_3H_8O_3+3(C_nH_{2n}—_1O.OK)$$

According to the above equation, every litre of normal potash solution splits up one-third equivalent of glycerine—*i.e.*, 30·667 g. 1 c.c. of normal potash is therefore equivalent to 0·030667 g. of glycerine.

**Berichte der deutschen Chemischen Gesellschaft*, May 21, 1883.

8. The amount of glycerine a fat would probably yield having been ascertained by the above titration, and provided the fat is pure and free from moisture, the theoretical yield of fat acids would be easily calculated.

Triglycerides may be considered to split up in the following way :—

$$C_3H_5(OC_nH_{2n-1}O)3=C_3H_2+3C_nH_{2n}O_2$$

On comparing this equation with the one above, 1 litre of normal potash represents one-third equivalent of glycerine residue, C_3H_2—*i.e.*, 12·667 g. Supposing v. c.c. of normal potash to have been employed, the weight of the glycerine residue would be (0·012667 v.), which may be represented by the letter g, and let F represent, in grammes, the original weight of the fat; then F — g will represent the yield of fat acids to be expected from it.—*Chemist and Druggist.*

CULTIVATION OF VANILLA IN MEXICO.

In Mexico vanilla is planted either in a forest or in a field. In the former case the underbrush, climbers and large trees are cut down and removed, and the young saplings only preserved to serve as supports to the vanilla plant, preference being given to trees having a milky sap. Near each tree two cuttings of the vanilla plant are placed side by side in a shallow trench one and one half inches deep and sixteen inches long, three knots of the stem being laid in the trench, and covered with dead leaves, brush, &c. The rest of the cuttings, to the extent of three or four feet, is placed against a tree and tied to it. The supporting trees should not be nearer than twelve or fifteen feet apart, to give sufficient room for the development of the plant. After a month the cutting will have taken root, and must be carefully kept from weeds and briars of all kinds. In the third year the plant begins to bear fruit, which it continues to yield for many years.

When the vanilla is cultivated in a field, the Mexicans first plough the ground thoroughly and raise on it a crop of corn. In the protection afforded by this plant, a number of young milk-bearing trees of the fig family grow, which in about twelve or eighteen months are large enough to answer as supporters to the vanilla plants, which are then placed as above described. In Mexico and Guiana the plant is allowed to climb up the trees, the fertilization of the flowers is left to nature, and a large number of flowers constantly remain unfertilized, and the yield of vanilla is small. In a few days after fecundation the flower falls off and the fruit continues to grow till the end of the first month; it takes, however, another five months before it is completely ripe. Each pod must be gathered separately, and not the whole cluster at once, the time to gather them being indicated by the pods cracking when pressed with the fingers. If too ripe, the pods split in drying, changing the colour from yellow to brown and black. If not ripe enough, the fruit will lack fragrance and proper colour. The ripe fruit has no odour at first, the agreeable odour of vanilla being developed by a process of curing. When the first fruit is drying an unctuous dark red liquid, called balsam of vanilla, exudes.

In Mexico the pods are collected and placed in heaps in a shed protected from rain and sunshine, and there left for a few days; they are then, if the weather is warm and clear, spread in the morning on a woollen blanket and exposed to the direct rays of the sun; at about midday the blanket is folded round the beans, and the bundle is left in the sun for the remainder of the day. In the evening it is enclosed in tight boxes to "sweat" all the night. The next day the same treatment is adopted, and the beans, after exposure to the sun, acquire a dark coffee colour, the shade being deeper in proportion to the success of the "sweating" operation. If the weather is cloudy the vanilla is collected into bundles, a number of which are packed together in a small bale, which is first wrapped with a woollen cloth, then with banana leaves, and finally with a stout matting, which is firmly bound and sprinkled with water. An oven is then heated to 60 deg. C., and the bales containing the larger beans are placed in it. When the temperature has fallen to 45 deg. C. the smaller beans are introduced and the oven closed tightly. Twenty-four hours afterwards the smaller beans are taken out, and twelve hours later the larger ones. The vanilla has then acquired a fine maroon colour. The drying operation then commences. The beans are spread on matting and exposed to the sun every day for two months. When the drying is nearly completed it is finished in the shade in a dry place, and the pods are then tied up in small bundles for sale.—*Oil, Paint and Drug Reporter.*

FOOD ADULTERATION IN FRANCE.

The following Analyses were made at the Paris Municipal Chemical Laboratory, during the month of May, 1883:—

Nature of the Samples Analysed.	Good.	Passable.	Bad.		Totals.
			Not Injurious.	Injurious.	
Wines	116	93	378	21	608
Vinegars	4	2	—	—	6
Beers	2	-	1	—	3
Ciders	2	-	—	—	2
Alcohols and Liqueurs.	2	2	—	5	9
Syrups	1	—	—	—	1
Waters	4	4	1	10	19
Milks	24	84	89	—	197
Malt	—	—	—	—	—
Butters	8	—	1	—	9
Oils	1	—	1	—	2
Flours	3	1	2	—	6
Dough, Bread	3	1	—	—	4
Sweetmeats	2	—	—	—	2
Meats	—	—	—	—	—
Preserves	3	1	—	4	8
Salt, Pepper	1	1	3	—	5
Chicory, Coffee, Tea	—	1	2	—	3
Chocolates	4	2	8	—	14
Honeys	—	—	—	—	—
Confitures	—	—	—	—	—
Colouring Materials	6	1	3	4	14
Toys	—	1	—	9	10
Coloured Papers	1	2	—	1	4
Tins	2	2	—	1	5
Spices	11	—	—	—	11
Pharmaceutical Products	2	—	—	—	2
Perfumery	—	1	—	1	2
Various	14	3	3	18	38
TOTAL	216	202	492	74	984

COFFEE AND MUSTARD MIXTURES IN NEW YORK STATE.

We reprint from the *Sanitary Engineer* the following regulations as to these mixtures:—

Albany, *March 28th*, 1883.

To the Editor of The Sanitary Engineer.

As the Governor has approved the action of this Board, as expressed in its resolution here annexed, I forward to you a copy for publication, as requested. Certainly, no coffee merchant will feel harmed, excepting he be of the class which this action compels to supply wholesome coffee instead of some spurious mixture.

The requirements of at least 40 per cent. of farina of mustard as the minimum of the article must "rule out" the chaff and dust that might pass in market as the mustard of trade but for this specification.

Respectfully yours,
ELISHA HARRIS, *Secretary*,
State Board of Health of New York.

"*Resolved*, That under and pursuant to Section 4 of Chapter 407 of the laws of 1881, the following mixtures when distinctly labelled in the manner provided in sub-division 7 of Section 3 of said Act, are within the conditions hereinafter prescribed declared to be exempt and permitted to be sold under the provisions of the said Act.

"1st. Coffee mixtures containing no other substances except chicory, peas or cereals, and in which mixtures the pure coffee shall not be less than 50 per cent. of the whole mixture or compound, provided that the exact percentage of coffee be printed upon the label of each package.

"2nd. Mustard mixtures with wheat or rice flour, to which no other substance, or article, or any colouring matter, except tumeric is added, and in which mixture the pure farina of mustard shall not be less than 40 per cent. of the whole mixture or compound, exclusive of the mustard hulls.

"The labels on the above mixtures shall contain the names of each and every ingredient of the mixture.

"The labels shall also exhibit the percentage of the characteristic constituents; for example, the percentage of coffee in the coffee mixture and the percentage of mustard in the mustard mixture.

"The above-mentioned information shall be printed on the label in black ink, in legible antique type, of a size easily to be read, on one side of the package."

Approved March 24th, 1883.
(Signed) GROVER CLEVELAND.

MILK ADULTERATION IN NEW JERSEY.

The first case under the food adulteration law of New Jersey was tried before Judge Fort of the District Court of Newark, May 24. The complaint was made by the City Milk inspector, Mr. Henry Negles, and charged Mary McGrath with offering for sale a quantity of milk from which a valuable constituent had been removed (skimmed milk).

The lawyer for the defendant asked for her discharge, on the ground that guilty knowledge had not been proved, and that sub-division 2nd, 3rd, 4th, 5th and 6th, and the 1st section of sub-division 7th must be construed in connection with the words in the first sub-division, as found in section 3 (B) of the act.

As the decision of the court is important, we give it in full.

First District Court of the City of Newark.—Henry Negles *v.* Mary McGrath.—Tried before the Court, May 24th, 1883.

The Court, Fort J. · This is an action under the act to prevent the adulteration of food or drugs, approved March 25, 1881, and the supplement thereto, approved March 23, 1883. The complaint in this case is for this: that the defendant did offer for sale an article of food, being milk, which was adulterated within the meaning and in violation of said act, in this, that a valuable constituent of said milk had been in part abstracted: that said milk was an imitation of, and offered for sale as pure milk, whereas the same was impure.

The evidence in this cause shows that the highest percentage of water in pure milk is 88 and the solids are 12 per cent. The defendant in this case keeps a store at No. 883, Broad Street, in the city of Newark, wherein she sells milk by the pint, quart, &c. In the present month, Henry Negles, the plaintiff, Milk Inspector of the city of Newark, visited her place of business, and procured a quantity of milk there on sale, and delivered it to Shipman Wallace, Esq , Chemist of the State Board of Health, who examined it and found that the said milk contained 89 per cent. of water and 11 per cent. of milk solids. It was further in evidence that 3 per cent. of the 12 per cent. of solids in pure milk was what the chemist denominated fat, or cream; that in the milk found in the defendant's possession this fat was found to be only 1·84, being 1·12 short of normal. The testimony of the Health Physician, Dr. Mandeville, is that such milk for some purposes is impure and unhealthy.

The defendant denies having abstracted any constituent from said milk, or that she knew that said milk was impure, and offered it for sale as pure. By the express language of the act under which these suits are brought, it is provided "that no person shall manufacture, have, offer for sale, or sell any article of food, or drugs, which is adulterated within the meaning of this act;" any person violating its provisions shall be liable to a penalty in the first instance of 50 dollars. By the second section of the act is provided that the term food, as used in this act, shall include every article used as food or drink by man. It is insisted that as the defendant had no knowledge, or claimed to have none, of the abstraction or adulteration in this case, no conviction can be had under this act.

We cannot give this construction to this law. The first section is broad enough to cover, not only the person who offers for sale, or sells, but any person who may have any article of food which is adulterated within the meaning of the act, in their possession for sale. In this case the defendant admits that she had the milk on sale, that she had sold some of it, and there is no dispute under the evidence, if the testimony of the chemist is true, but that a valuable constituent, to wit: 1·12 parts of the cream of this milk had been abstracted, or in other words, this was what the chemist called "skimmed milk."

Secondly.—If the chemist's testimony is true, it is also proven in this case that the milk had by the defendant was adulterated by the addition of some foreign substance, whether water or other substance, the grade of this milk being 89 per cent. of water, which is one per cent. of water in excess of the proper percentage. One per cent. is said by the chemist, in either solids or liquid, to be a very wide divergence from the normal, as he is able to detect, and always concludes that he has made an error unless he can accurately arrive at least one-tenth of one per cent. of the true condition of the milk analysed. It is insisted that sub-division second, third, fourth, fifth and sixth, and the first section of sub-division seven, must be construed in connection with the words in the first sub-division as found in section three, of the act of 1881, above referred to (B), which words read as follows: "So as to reduce or lower, or injuriously affect its quality or strength."

This construction the Court cannot sustain; these words can only be in qualification of the sub-divisions in which they stand for the reason that said sub-division is general, and the other sub-divisions are specific, referring to the particular reasons for condemnation of the food alleged under either one of them to be improperly sold. The first sub-division relates to any substance, or substances; the third, only to valuable constituents abstracted; the fourth, to imitations sold under the name of the real article; the fifth, to food from diseased, putrid, or rotten animal or vegetable substance; the sixth, to covering up by coloring or coating the damaged article; seventh, the addition of poison or ingredients. In the charging of this offence in the act, stating the title and date of approval in the complaint and summons is sufficient, and if it shall appear to the satisfaction of the Court that the conditions exist as charged, and the defendant sold, or offered for sale, or had for sale the article in its deteriorated condition, he shall be held under the provisions of this law.

In this particular case the defendant will be adjudged guilty, and the penalty of fifty dollars imposed with costs.

In the cases of same plaintiff against Otten, same plaintiff against Bahrenburg, and same plaintiff against Sievers, the defendants will be found guilty and the like penalty of fifty dollars in each case imposed with costs.

ESTIMATION OF TANNIN.

F. **Simand** has abandoned the use of Löwenthal's improved method of estimating tannin, as he found that the percentage of tannin in the same material was subject to certain variations. A series of experiments was therefore made, the object being to replace the gelatin used by Lowenthal by a substance capable of absorbing tannin. The method was founded on oxidation, with potassium permanganate or calcium hypochlorite, with indigo solution as indicator in presence of sulphuric acid. The first substance experimented with was powdered skin, which Hammer and Löwenthal had used some time ago for extracting tannin from solutions. Although more satisfactory results were obtained than with gelatin, the absorption of the tannin was a slow operation, requiring often 24 hours' agitation or more, and even then tannic acid was present in the filtrate; moreover, the difficulty experienced in preparing the skin rendered this method impracticable. The author then tried the gelatinous tissue of bones. Tubular bones were treated with dilute hydrochloric acid, and after removing the lime salts the residue was washed and used for extracting tannic acid from infusions. The results were as satisfactory as those obtained with powdered skin, whilst the absorption of the tannin was effected more readily. Later on, when Muntz showed that tannin is absorbed by nitrogenous vegetable substances, the author, assuming that all nitrogenous animal substances softening in water are capable of absorbing tannin, used horn shavings after removing the lime salts, with equally good results. In the original paper, the method pursued by the author in his laboratory for preparing the skin powder, extracted bones and horn shavings, is described in detail, and numerous tannin estimations with these substances are given.

PRESERVATION OF CAUSTIC SODA.

The difficulty experienced in preserving caustic soda in a powdered state, owing to the tendency of its particles when exposed to the atmosphere, to deliquesce and combine and mass together, is said to be overcome by mixing with the powdered caustic soda a quantity of powdered sand or sandstone sufficient to protect the particles of powdered caustic soda from such contact with each other as will cause them to combine and mass together, and also sufficient to shield, in a measure, the particles of caustic from contact with the atmosphere. Caustic soda thus treated is applicable generally in the arts, and can be handled with greater facility than the ordinary commercial article.

Where it is to be used as a flux in the manufacture of cast iron, one part of ground sand or sandstone may be used to five parts of ground caustic soda; but the quantity of powdered sand or sandstone may be materially increased, though a less amount will not prove effective. While the powdered sand operates in a measure to protect the caustic soda from atmospheric influences, and from such contact of its particles as will permit them to mass together, there is no chemical combination between the sand and caustic soda which would cause it to solidify and harden, as would be the case were powdered limestone, for instance, used.

In practice the caustic soda and sand or sandstone are ground up to a powder, either separately or together, and immediately mixed. From the facility with which the article prepared can be handled, it is especially adapted for use as a flux in the manufacture of cast-iron, though for the same reason it also commends itself to the trade generally.

This method of treating caustic soda has been patented.—*Oil, Paint and Drug Reporter.*

Mr. B. A. Burrell has been appointed Public Analyst for the city of Cork.

Mr. T. Stenhouse has been appointed Public Analyst for the borough of Rochdale, *vice* Collinge, deceased.

PROCESS FOR THE RECOGNITION OF HYDROCYANIC AND OTHER ACIDS.

By A. Longi.

The substance under consideration is dissolved in water and the solution acidulated with acetic acid. If insoluble in water it is heated to a boil with sodium carbonate, and the filtrate is acidified with acetic acid. After any hydrogen sulphide present is expelled, silver nitrate is added in slight excess, and a little nitric acid. The precipitate may contain silver cyanide, chloride, bromide, iodate, ferrocyanide and ferricyanide. In the solution may be present silver chlorate, bromate (in part) and mercuric cyanide. The liquid A is separated from the precipitate B and examined separately.

A. In the liquid hydrogen is liberated by means of zinc and a little sulphuric acid. Silver chlorate and bromate are reduced to the corresponding chloride or bromide, and both these along with mercuric cyanide, to metallic silver and mercury, hydrogen, cyanide, chloride, and bromide being formed. When the reaction is at an end the mixture is filtered and the filtrate is divided into three parts.

The first part is tested for cyanogen with a ferric ferrous salt.

To the second part is added silver nitrate, which separates hydrocyanic, hydrochloric, and hydrobromic acids. The precipitate is washed and digested in ammonia of sp. gr. 0·998. If the liquid filtered from the precipitate gives with nitric acid a white precipitate, insoluble in concentrated boiling nitric acid, chloric acid was present.

The third portion was tested for bromine with carbon disulphide. The presence of bromine shows that the original substance contained bromic acid.

B. The precipitate is carefully washed, and then digested in ammonia of sp. gr. 0·998. The cyanide, chloride, bromate, iodate and ferricyanide dissolved, but not the bromide, iodide, and ferrocyanide.

The residue is washed and treated with a solution of hydrogen sulphide to which a little hydrochloric acid has been added. It is heated to expel excess of hydrogen sulphide and filtered.

The filtrate is tested for hydrogen ferrocyanide with a ferric-ferrous salt. Any ferrocyanide formed is filtered off, and the filtrate is tested for bromine and iodine with carbon disulphide.

The ammoniacal solution, which may contain cyanide, chloride, bromate, iodate and ferricyanide, is treated with sulphurous anhydride. Cyanide and chloride are separated out, bromate, iodate, and ferricyanide are reduced to bromide, iodide and ferrocyanide, and thrown down as such. The precipitate is washed by decantation and digested in ammonia. The cyanide and chloride are re-dissolved, but not the bromide, iodide and ferrocyanide. The mixture is filtered. The solid matter is tested for bromine, iodine, and hydrogen ferrocyanide as above directed. Their presence shows that the original substance contained bromic and iodic acids and hydrogen ferrocyanide.

To the liquid is added nitric acid by which cyanide and chloride are re-precipitated. The precipitate is divided into two parts. The one is treated with a little dilute hydrochloric acid and filtered. The filtrate is tested for hydrogen cyanide with a ferric-ferrous salt. The other portion is heated to boil with concentrated nitric acid. Cyanide is thus converted into nitrate, whilst chloride remains unchanged.—*Gazetta Chimica.*

CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

SOMERSET HOUSE AND MILK ADULTERATION.

To the Editor of "The Analyst."

Sir,—Permit me to make a few remarks concerning the important Milk Adulteration case reported in all city papers this morning.

The samples in question Nos. 203-4 were brought by the Inspector to me for division, hence I knew they were from a dairy, and not from a single cow. It was therefore not necessary to take any single cow's milk as standard, and accordingly the limit agreed to by the Public Analysts' Society was taken. That this course was the proper one, was proved from the results of the Somerset House investigation, for in their book just published I find the average solids not fat given as 9 per cent. I found 8·66 and 8·67 solids not fat respectively in my samples. If further proof was needed of the indulgence with which milk producers are treated by Public Analysts, it is afforded by the fact that a sample of milk was obtained by our officials direct from the defendant's cows, and this gave 9·6 per cent. solids not fat. This analysis could not be put in evidence as it was to be taken without prejudice.

May we hope, now that the Analysts of Somerset House have published their perfected researches upon the Milk question, that, after fair criticism, they and ourselves may agree not only upon what shall be *deemed* pure milk, but upon the *process* to be used in milk analysis.

Of course I need not say they must expect criticism; for the three gentleman who represent Somerset House in this question can scarcely claim the infallibility for themselves which they deny to the large body of chemists included in our Society.

Yours, &c.,
C. ESTCOURT.

City Laboratory, Manchester, June 28th, 1883.

LAW REPORTS.

ANALYSING SOUR MILK: IMPORTANT EVIDENCE BY SOMERSET HOUSE CHEMISTS.

At the Manchester City Police Court, on Wednesday, 27th June, a case of exceptional importance to Public Analysts, and persons engaged in the milk trade, was decided. The defendant was Richard Wardle, a Derbyshire farmer, and the prosecutors were the Manchester Corporation, who charged him with consigning to Anthony Hailwood, a milk dealer, a quantity of new milk which, according to the certificate of Mr. Charles Estcourt, F.C.S., Public Analyst for Manchester, contained four per cent of added water. The case was first before the court on the 9th of May, the magistrates present being Charles Lister, Esq. (solicitor) and W. Aronsberg, Esq. In consequence of the request of defendant, the court directed that the duplicate samples taken should be sent up to Somerset House for analysis by the Government analysts, and the case was adjourned to await the result. The certificate received from that office, signed by Mr. James Bell, the senior analyst, and Messrs. R. Bannister and G. Lewin, stated that the samples were received at Somerset House on the 10th of May, and had been duly analysed by them. That numbered 203 contained 8·20 per cent. non-fatty solids, 2·80 per cent. of fat; and 89·00 of water; ash, ·81 per cent. After making an addition for natural loss arising from decomposition of the milk through keeping, the proportion of non-fatty solids was not, in their opinion, lower than is found in genuine milks. The percentage of fat and ash were equal to those found in genuine milks. From a consideration of these results they said: "We are unable to affirm that water has been added to the milk." Sample No. 204 contained 8·02 per cent of non-fatty solids, 3·01 of fat, and 88·97 of water, the ash being ·75 per cent. The remarks of the three analysts with reference to this sample were precisely similar to those made in the other certificate. Mr. Bell was now in attendance as a witness, the corporation having subpœnaed him with the object of eliciting from him (if possible) the method by which he arrives at his conclusions, and the standard of purity he adopts. Mr. Hopkinson, barrister, appeared for the prosecution, and Mr. Briggs, solicitor, of Derby, for the defence. Mr. Lister was again the presiding magistrate, his colleague being Mr. J. Furniss. From the evidence of Inspector Edwards, it appeared that on the 23rd of April he went to the Central Station, Manchester, with Mr. Hailwood, and at his request took a sample of milk from each of two cans consigned to him by the defendant. These samples, which he numbered 203 and 204, were sent to the City Analyst, whose certificates declared them both to contain four per cent. of added water, and that no change had taken place in the composition of the samples that would in any way interfere with the analysis.

In cross-examination by Mr. Briggs, the Inspector said he mixed the milk up by pouring a portion from the churn into a 2-dozen quart can, and then pouring it back in the churn, this operation being repeated twice. He did not entirely empty the churn. He rather thought it was morning's milk that he took, but he could not be certain, He had however, a reason for taking the morning's milk in preference to the night's milk, and that reason was that the complainant, Mr. Hailwood, particularly requested him to take the sample from the morning's milk.

Mr. Hailwood's evidence was to the effect that the defendant was under an agreement to supply him with new milk at 2s. 6d. per dozen quarts in winter, and 1s. 11d. in summer: that the samples were taken from morning's milk only; that he cautioned the defendant in January last about the milk not being right, and that upon analysis it was found then to contain added water.

Mr. Hopkinson said he should now like to ask Mr. Bell some questions in reference to this matter, as it involved principles of very great importance, both as to the mode of analysing, and as regards the standard of purity, which ought to be maintained, for he submitted that an adulteration to the extent of even four per cent. only, meant a loss of £10,000 a year to milk consumers in Manchester, assuming the consumption to average no more than a pint per day for each house.

Mr. James Bell was then sworn, and said he was the senior analyst at Somerset House. In order to discover whether water has been added to the milk, Public Analysts ascertained the proportion of non-fatty solids, but at Somerset House they take the whole of the constituents into account. The quantity of added water was usually calculated according to the quantity of non-fatty solids. He had found the per-centage of non-fatty solids in fresh milk to vary from 8·02 to over 10. He remembered a case, in which a sample was sent to him from Chester, by the magistrates, which the Public Analyst certified to contain added water, in which he (Mr. Bell) found by his own analysis, the non-fatty solids were considerably below 8 per cent. That was taken from *one* cow, and was analysed in a day or two afterwards.

Mr. Hopkinson: Then may I take it that you will pass milk as containing no added water if the non-fatty solids are less than 8 per cent.?

Witness: It depends entirely upon the result of the analysis, taking the whole constituents into account.

Mr. Hopkinson: What is your method of analysing milk? Do not you first evaporate it?

Witness: We first weigh out a quantity, and then evaporate it: fresh milk from 5 to 8 grammes, and sour milk 10 grammes, a solid residuum being left. From the fresh milk we take out the fatty solids by means of ether which dissolves the fatty matter, and leaves the non-fatty. We then determine the ash. In the two certificates produced, the ash is included in the 8·02 per cent. of non-fatty substances. In the case of sour milk we weigh one portion for total solids; then weigh two separate quantities in platinum capsules, then we neutralise them, and they are evaporated, two for the non-fatty solids and the fat; the other being dried completely without any further addition. The two for non-fatty solids are treated with ether until we get all the fat abstracted. The non-fatty solids we place in the bath for drying, and keep them there from 4 p.m. until 10 a.m. They are then weighed every two hours till we get a constant weight, then the soda is deducted. The certificates show the true non-fatty solids. The acids are fixed by the alkaline solution. The decomposition in this case was not excessive and there was nothing to prevent his making a reasonable analysis of it.

Mr. Hopkinson: Was there no escape of gas?

Witness: Oh yes, there was some escape; that is the reason of the loss. There was a little alcohol produced.

Mr. Hopkinson: Then how much do you allow for loss of alcohol?

Witness: We do not say it is for alcohol; we say for loss of non-fatty solids, which includes the milk sugar and casein? We have applied the same process for the last eight years.

Mr. Hopkinson: Do you allow so much per day for loss?

Witness: Yes.

Mr. Hopkinson: How many days' loss did you allow in this case?

Witness: Nearly 20.

Mr. Hopkinson: What rate per day do you allow for loss for that time?

Witness: For the first week $\frac{24}{100}$, for the next 14 days $\frac{34}{100}$, and for 21 days $\frac{41}{100}$ We allow $\frac{38}{100}$ in this case. That is the general rule by which we are governed in allowing for loss, but if we find any circumstances which alter our opinion we deviate from the rule. I should say this milk, when fresh, contained somewhat under 8·6 of non-fatty solids.

Mr. Hopkinson: Then may I understand that the authorities at Somerset House receive as pure milk, milk containing only 8·5 per cent. of non-fatty solids?

Witness: No; it depends on the other constituents.

Mr. Hopkinson: I understood you to say that you determine whether there has been water added by the amount of non-fatty solids?

Witness: For reckoning the presumed quantity of added water we take the non-fatty solids as the basis.

Mr. Hopkinson: Then, for how much of non-fatty solids do you say there is added water?

Witness: We do not specify any quantity; we say it contains not less than so and so.

Mr. Hopkinson: When the non-fatty solids reach a certain quantity, do you say there is added water?

Witness: No.

Mr. Hopkinson: Supposing you found four per cent. of non-fatty solids, would you say there is added water?

Witness: I should say, from my experience, it was not genuine milk, and treat it accordingly,

Mr Hopkinson: But would you say there was added water?

Witness: Certainly.

Mr. Hopkinson: If there were 7 per cent. of non-fatty solids would you pass it?

Witness: No, I should not.

Mr. Hopkinson: Would you if there were 8 per cent.?

Witness: Not without some inquiry.

Mr. Hopkinson: Then when would you pass it?

Witness: It depends entirely on the analysis.

Mr. Hopkinson: Would you pass it at 8·2?

Witness: No, not without enquiry.

Mr. Hopkinson: But at 8·5 you would pass it?

Witness: I should not be disposed to say much about it then.

Mr. Hopkinson: Would you pass it?

Witness: I should if the whole of the constituents were those of genuine milk.

Mr. Hopkinson: Is not the fat in this milk the normal quantity or nearly so?

Witness: It is a fair quantity.

Mr. Hopkinson: Then there was nothing to show as regards the fatty solids that it had been adulterated?

Witness: No.

Mr. Hopkinson: Then I understand you to say that if there is 8·5 per cent. of non-fatty solids, and nothing else to show that it has been adulterated, you will pass it?

Witness: Yes.

Mr. Hopkinson: Would you pass it at anything under 8·5.

Witness: I should.

Mr. Hopkinson: Would you pass it at 8·2?

Witness: No, I should not.

Mr. Hopkinson: Would you at 8·3?

Witness: No.

Mr. Hopkinson: Nor at 8·4?

Witness: Yes, if the other constituents were right.

Mr. Hopkinson: Then you draw the line somewhere between 8·3 and 8·4. Now, is it not the fact, as shown by thousands of analyses made by Public Analysts, that the non-fatty substances average about 9 per cent. in pure milk?

Witness: That is so according to certain processes, but it would not be so by this process. My average is higher than Mr. Wanklyn's, because mine is founded on complete dryings.

Mr. Hopkinson: Mr. Wanklyn's is 9 3, and you say yours is something over 9.

Witness: It varies in individual cows.

By the Chairman of the Bench: The results of our analysis are consistent with the milk being genuine, and it would be utterly impossible for us to say that water had been added.

The Chairman: And do you go further, and say that no analyst could ascertain that fact?

Witness: Certainly, it would be impossible.

The witness was then cross-examined by Mr. Briggs, but no additional fact was elicited thereby. In reply to the Chairman, he said his experience was that cows fed on grass give richer milk than stall-fed cows.

Mr. Carter Bell, Public Analyst for Cheshire, Salford, and other places, was called as a witness for the prosecution. He had tested about 2,000 samples of milk, in 300 or 400 of which he had actually seen the cows milked. As a rule, he had found the milk of healthy and properly fed cows to contain upwards of 9 per cent. of non-fatty solids. Four per cent. of added water for the milk in this case was in his opinion very low, as there might be 10 per cent. There must be at least 4.

By Mr. Briggs: I should not expect the non-fatty matter to be as low as 8·2 in the milk of a healthy cow. If you were analysing the milk of a thousand cows you might find it so low in some of them. Specific gravity is not a sure test; it is one of the most fallacious, when taken alone. I invariably find that the average proportion of non-fatty solids is from 9·3 to 9·4, and this milk according to the Public Analysts' standard would contain 4 per cent. of added water.

Mr. Briggs: Why do you take 9 per cent. as your standard?

Witness: Because it is the percentage laid down by the Public Analysts, who represent the analyses of about 10,000 cows, and they have found 9 per cent. to be a very low standard.

Mr. Briggs: Then if you had taken your standard at 8·5 instead of 9 you would have said there was no added water?

Witness: If the Act of Parliament defined it as pure milk at that standard, I should not dispute the law, but I should still be of opinion that it contained added water.

Mr. Hopkinson: That is to say it would be parliamentary milk, but not natural?

Witness: Quite so.

In reply to the Chairman, witness said his experience was that stall-fed cows give richer milk than cows fed on grass.

Richard Wardle, the defendant, was called, and denied that any water had been added to the milk. In reply to Mr. Hopkinson, he said he had sent a sample of the milk to be analysed by Mr. Wilkinson, the analyst for Stockport, who said there was about 3 per cent. of added water in it. He had also sent one to Dr. Otto Hehner, of London, who, he believed, said there was more than 3 per cent. He had a refrigerator, for the cooling of his milk, and had plenty of water on his farm: very good water too.

By Mr. Briggs: It would not be possible for water to get into milk accidentally.

Mr. Wilkinson said he had taken the same standard as Mr. Estcourt, and his certificate showed that there were 8·66 per cent. of non-fatty solids, and 2·86 of fat.

Mr. Estcourt was tendered by Mr. Hopkinson, as a witness, for the purpose of giving Mr. Briggs an opportunity of questioning him, but the latter did not avail himself of the privilege.

Mr. Bell then intimated that he had brought two of his assistants with him, whom he would like to be examined.

Mr. Hopkinson said he had not subpœnaed anyone from Somerset House except Mr. Bell, whom he recognised as the responsible authority there, and having examined him, he should decline to call anyone else.

Mr. Briggs said, in that case, he should call them. He then addressed the court for the defence. He said, they were asked to rule that no milk should be accepted in Manchester, as pure, which does not come up to the standard laid down by the Public Analysts, and he submitted that the Bench had no right to rule anything of the kind. The only question they had to decide was, had this milk been adulterated or not. Both the defendant and his man, who superintended the milking and transmission of the milk, positively declared that no water was added, yet the Bench were asked to ignore that evidence, because the milk did not come up to the standard of the Public Analysts.

Mr. Richard Bannister and Mr. G. Lewin, were then examined by Mr. Briggs, and the Chairman of the Bench, their evidence being substantially a repetition of that given by Mr. James Bell.

The Chairman, then asked Mr. Bell, of Somerset House, if there was a greater difficulty in analysing sour milk than fresh milk.

Mr. Bell: None whatever.

The magistrates then retired to consider the evidence, and on returning into court, Mr. Lister said that inasmuch as Mr. Estcourt, Mr. Wilkinson, Mr. Hehner, and Mr. Carter Bell all declared that water had been added to this milk, and neither Mr. James Bell nor the other gentlemen from Somerset House could say that it had not, the Bench were of opinion that there must be a conviction. The defendant would be fined 20s. and the ordinary court costs.

RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

No. 1882.	Name of Patentee.	Title of Patent.	Price.
1618	J. B. Rogers..	Electric Lamps	6d.
4590	W. Clark	Secondary or Storage Batteries	2d.
4625	St. G. L. Fox	Secondary Batteries	6d.
4658	A. J. Boult	Purification of Alcohol	6d.
4659	J. Young	Treatment of Sewage	8d.
4676	J. F. Phillips	Incandescent Electric Lamps	6d.
4692	A. W. Reddie	Manufacture of Bicarbonate of Soda	6d.
4695	E. Edwards & A. F. St. George	Electric Lamps	6d.
4709	A. J. Boult	Concentrating Sulphuric Acid	2d.
4714	E. W. Parnell & J. Simpson	Manufacture of Alkalies	6d.
4733	W. H. Beck	Process for Integral Extraction of the Constituent Principles of Fatty Bodies	6d.
4735	C. T. Kingzett	Secondary Batteries	4d.
4756	A. Khotinsky	Secondary Voltaic Batteries	2d.
4758	J. & J. Addie	Obtaining Ammonia from Furnace Gases	6d.
4769	A. Neilson & A. C. Thomson	Treatment of Carbonaceous Minerals for Oil, Ammonia, &c.	8d.
4780	S. F. Walker & F. G. Olliver	Electric Lamps	6d.
4809	R. Tatham & A. Hollings	Secondary Batteries	4d.
4816	E. J. Wimshurst	Voltaic Batteries	2d.
4832	J. H. Johnson	Telephones	6d.
4880	A. M. Clark	Electric Arc Lamps	6d.
4883	P. R. de Faucheux d'Hamy	Electric Lamps	6d.
4911	J. Allmann	Electric Lamps	2d.
4984	G. W. Von Nawrocki	Manufacture of Chloride of Lime	2d.
4991	J. E. Liardet & T. Donnithorne	Secondary Batteries	4d.
5021	J. Prosser	Combining Salicylic Acid and Glycerine for Admixture with Wines and Spirituous Liquors	2d.
5030	H. A. Bonneville	Manufacturing Anhydrous Alumina	4d.
5071	W. R. Lake	Manufacture of Sugar	6d.
5084	W. Young & G. T. Beilby	Treatment of Coal, &c., for Ammonia	1/0
5097	R. Hammond & L. Goldenberg	Secondary Batteries	2d.
5098	A. Mackean	Electric Lamps	2d.
5112	J. Imray	Separating Glycerine from Fatty Matters	2d.

BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Practicien; The Inventors Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review.

THE ANALYST.

AUGUST, 1883.

SOCIETY OF PUBLIC ANALYSTS.

The Country Meeting of the Society of Public Analysts was held on July 21st, by a trip up the Thames to Maidenhead, Henley and Sonning.

The Members who took part in the excursion assembled at Paddington, at 9 a.m., took train to Taplow, and at Maidenhead—on the opposite side of the river, embarked in a steam launch, kindly furnished by Mr. Wigner, the President. Lunch was served on board, and an excellent dinner at the "French Horn," Sonning. Most of the excursionists returned by launch to Maidenhead, arriving very late at Paddington, after having spent a most enjoyable and satisfactory day.

The names of Mr. J. McCarthy, Government Analyst, Trinidad, and of Mr. A. Percy Hoskins, were read; the former for election as Member, the latter as Associate.

ANALYSIS OF A SAMPLE OF NEW ZEALAND COAL.

By Otto Hehner.

Read before the Society of Public Analysts on the 28th June, 1883.

Some discussion having recently taken place as to the value of New Zealand Coal as a fuel, the following results of a somewhat full analysis may be worthy of being placed on record.

The sample to which the results refer consisted of large brownish black lumps, many of which showed woody structure; the fractures were conchyloid, the surface shiny and highly reflecting. It was interspersed with a considerable amount of an amber coloured resin. When powdered it appeared chocolate-brown. It burned readily, the flame being bright and very smoky. Its ash was light and reddish brown.

It consisted of :—

Water (loss at 212° F)	20·09
Organic and Volatile Matter	75·19
Ash	4·72
	100·00

The organic and volatile constituents had the following percentage composition :—

Carbon	71·26
Hydrogen	5·62
Oxygen	21·58
Nitrogen	1·06
Sulphur	·48
	100·00

The ash was composed of :—

Silica	27·26
Alumina	26·48
Oxide of Iron	12·98
Lime	20·19
Magnesia	3·42
Sulphuric Acid	9·47
Alkalies and Loss	0·20
	100·00

From these figures the composition of the coal itself calculates as under :—

Water	20·09
Carbon	53·58
Hydrogen	4·23
Oxygen	16·23
Nitrogen	·80
Sulphur	·36
Silica	1·29
Alumina	1 25
Oxide of Iron	·61
Lime	·95
Magnesia	·16
Sulphuric Acid	·44
Alkalies	·01
	100·00

One ton furnished 8458 cubic feet of gas and 8 cwt. of coke.

The very high proportion of water contained in the sample is very remarkable. It was so loosely combined, that even at ordinary temperature it gradually escaped, the coal crumbling to small pieces. The large amount, as well as the high percentage of oxygen characterise the so-called coal as a *lignite*, with which conclusion the physical characters of the sample are in perfect harmony.

The resin to which I have referred has not been further analysed. It was found to be insoluble in all ordinary menstrua, such as alcohol, ether, carbon disulphide, benzene or chloroform, and neither attacked by boiling alcoholic potash, nor by fusing alkali. On heating it swells up considerably and undergoes decomposition, but does not fuse.

The coal may be valuable as a gas coal and for local consumption, but the large proportions of water and of oxygen militate against its use as a steam producer, only 58 per cent. of it being really combustible.

THE CAUSE OF A PECULIAR CONDITION OF SOME AMERICAN WATER SUPPLIES.

By Chas. R. Fletcher, Lecturer on Chemistry, Boston University ; State Assayer, Massachusetts.

Read before the Society of Public Analysts, on 27th June, 1883.

The peculiar, disagreeable, and truly alarming condition of the public water supply of the city of Boston, about a year ago, caused anxiety and alarm: for the cause of the contamination was unknown, although sought for at different times by the chemist of the Water Commissioners ; and the bad flavor and odor caused illness and disgust ; and the water works had already cost several millions of pounds, and now the supply had been several times affected by a similar flavor during several years, for a short period and in less degree. The valuable water supplies of eleven other cities had been also affected, since 1864, with probably the same trouble. In the winter of 1881-2, the Boston supply was very bad, not fit for domestic purposes on account of the odor and flavor. This has been commonly recognised under the name of "cucumber taste," as it resembles somewhat the taste of water in which cucumbers had soaked. But now the taste was worse, almost fishy, and often caused nausea, and always disgust.

It gave me pleasure to examine the water from a chemical point of view, with analyses, and report to a leading society of physicians, called together to discuss the situation; for the physicians were aroused, and the people anxious. The only thing I noted was the higher percentage of "albuminoid ammonia" than that reported in previous analyses of this water. Expressing the belief that with an appropriation of a small sum the cause could be now detected in some low form of vegetable (possibly animal) growth, the sum was being raised, when the Water Commissioners were aroused by the public cry and compelled to order an investigation.

A chemist had been employed to make analyses for years, but had never found the cause, possibly in consequence of unfavorable conditions.

The common sense and scientific examination carried out in 1881-2 was successful, and is of great value.

It was found that the bad flavor was intensified by heat, and also the odor—which was slight when the water was cold, became very strong and disagreeable. Samples of the water were collected under many different conditions, from the surface and at depth, and from all points of the supplies.

It was found by chemical analysis of filtered and of unfiltered water, taken from the different positions in the lakes and reservoirs, 1st, That there was considerably more nitrogenous matter in suspension at the effluent gate-house (of the storage basin which was particularly affected) than at the influent gate-house; and 2nd, That there was not much difference in the amount of such matter *in solution* in the two specimens.

Unfiltered Specimens.	Free Ammonia.	Albumin. Ammonia.
Influent gate-house (10)	0·00	0·272
Effluent gate-house (10)	0·026	0·150
Filtered Specimens.	**Free Ammonia.**	**Albumin. Ammonia.**
Influent gate-house (10)	0·034	0·274
Effluent gate-house (10)	0·032	0·296

The increase in the amount of free ammonia, noticed by comparing the latter table with the former, is due to the fact that the specimens stood one day longer in one case than in the other case, before the analyses were made. It was found that the waters undergo a gradual change by standing, and that the results of this change can be detected by analysis. The change consists in further oxidation of the nitrogenous matter, leading to an increase in the amount of free ammonia, and finally to destruction of the material which imparts the taste and odor to the water. Chemical analyses were made of specimens from all portions of the supplies—both those affected and those not affected by the bad flavor, It was found that the chemical evidence was in accordance with that obtained by the senses. that is, the waters which tasted "fishy," "metallic," cucumbery," contained more "albuminoid ammonia," than those which did not carry the bad flavor.

An attempt was then made to determine whether the substance which caused the taste was at the bottom of the lake or not. The mud when first filtered from the water had no odor, nor the water any bad taste at such depth. The question at once suggested itself: Did the taste come from something situated on some other part of the bottom, or might it be developed by contact of the mud and bottom water with air?

A thin layer of the mud on a filter paper gave in half-an-hour the same odor, which increased for a time then disappeared. There was evidently something in the bottom mud capable of giving the odor, by contact with air. A careful microscopic examination revealed plants belonging to the Nostoc family in quantity. Some were separated but gave no odor. Spicules of a sponge were also noticed, and later an examination of the screens at the gate-house showed an amount of this sponge, with the grass and leaves which had collected there. The same bad odor was there more manifest, and a series of experiments showed that the odor came from this *fresh water sponge*. All agreed that the odor from it was identical with the peculiar flavor of the water.

The specimen is known as *Spongilla fluviatilis Anct.* It abounds in some localities, easily decomposes, and gives then a very strong odor. By drawing off the water from one water basin, large quantities were found in some places growing on rocks, from which it was easily detached. The experiments connected with this investigation were conducted according to the English rules of chemical analysis. The best way to detect the odor in water but slightly affected was to pass a pint or so through ordinary filter paper. This paper will then reveal the odor, though it may be quite impossible to detect it directly, even when the water is heated. This test is delicate, and may sever others. Indeed, it is in the hope that a knowledge of this trouble in America may be of service to the Public Analysts of England that I have requested of the Water Commissioners access to the report, the substance of which is here presented.

As this flavor has been occasionally noticed since 1854 in this country, it is of peculiar interest in connection with the valuable statistics and discussions on water supplies of the Society of Public Analysts, England.

In connection with this condition of the Boston water there were various representatives, unjustly dignified by the name of "theories," sometimes by intelligent, usually by ignorant men, who possessed practically no knowledge of the subject.

The value of this successful investigation in stopping anxiety and alarm (for as soon as the cause was known, a remedy soon followed), in pointing out to other large cities the probable cause of a similar condition, and in regaining the respect of the press and the public for chemical analysis of waters, was large.

COFFEE AND CHICORY LABELLED AS A MIXTURE.

At a recent meeting of the Manchester and Salford Grocers' Association, a case was mentioned which tends to show what the opinion of the Home Office is where traders have been convicted for selling this class of goods. The case was that of a firm of grocers named J. M'Mitchell and Co., Barrow-in-Furness, who were summoned before the local magistrates under the Sale or Food and Drugs Act, for selling a mixtute of chicory and coffee. The magistrates fined Messrs. M'Mitchell £5 and costs, although it was proved that the article was labelled as an admixture of coffee and chicory, and that the defendants' assistant told the person who purchased it that it was not pure coffee, but a mixture of coffee and chicory.

Messrs. M'Mitchell and Co., wrote to the Home Office on the subject, and received the following reply:—

"Gentlemen,—I have laid before the Secretary of State your letter of the 19th inst., calling attention to the proceedings against you under the Sale of Foods and Drugs Act, and I am to acquaint you that he must decline to interfere with the decision of the justices.

I am, gentlemen, your obedient servant, A. F. C. LIDDELL."

APPLICATION OF THE COPPER-ZINC COUPLE TO THE ESTIMATION OF NITRATES IN WATER.

By Robert Brewer Lee, B.Sc., F.S.C.,
Of Birkbeck Laboratory, University College, London.

Some time ago I had occasion to consider the most readily available methods of estimating nitrates in the process of water analysis.

Crum's method by reduction to nitric oxide was found most satisfactory for regular use in the laboratory; but we were also in need of a handy method applicable in circumstances where few of the appliances of an analytical laboratory were accessible.

In the *Journal of the Chemical Society*, vol. xxxix, page 100, Mr. Whiteley Williams describes a process of reducing the nitric acid to ammonia by a copper-zinc couple, and nesslerising a few cubic centimetres of the water so treated.

On endeavouring to repeat Mr. Williams' experiment, only inaccurate results were obtained. After trying various modifications of the method, I came to the conclusion that the following are the conditions of greatest accuracy.

1. The nitric acid should only be present in small quantity—best not more than 10 or 12 grains per gallon. Waters containing more than this should be proportionately diluted with distilled water.

2. The couple is most active in slightly acid solutions. I find it best to acidify with oxalic acid, which has the advantages both of precipitating the lime, and of forming an insoluble compound with the zinc.

The method of procedure is as follows:—The couple is made by immersion of clean zinc foil in a 3 per cent. solution of copper sulphate for 10—15 minutes. It is then gently washed, and about 1 square decimetre placed in a wide-mouthed stoppered bottle of 300—400 c.c. capacity. About 0·5 gramme of oxalic acid is added, and the bottle filled with the water to be analysed. The reduction may then safely be assumed to take place in the cold in 24 hours. But if the bottle be heated in a water-bath to 55°—60° C. the reduction will be found to be completed in 1½ to 2 hours.

From 2 to 10 c.c. of the water are now carefully withdrawn in a graduated pipette, made up to 50 c.c. in the Nessler glass with ammonia-free water, and nesslerised in the usual way.

The use of oxalic acid enables the temperature to be raised to 60° C. without loss of ammonia, and the reduction is then completed rapidly. The oxalic acid used must of course be free from ammonia and nitric acid.

Attempts were made to use granulated zinc instead of zinc foil for making the couple; but the couple so obtained was weaker and more uncertain in its action.

The following are the results of the experiments made. When not otherwise stated, I worked upon dilute solutions of potassium nitrate of known strength; but in the case of natural waters the figures obtained are compared with determinations by Crum's method.

As the work was with a view to water analysis, the results are stated in grains per gallon of nitric acid (N_2O_5).

In the first seven experiments, granulated zinc was employed for making the couple, and the quantity of oxalic acid varied from 1 to 2 grams.

	N_2O_5 present.	N_2O_5 found.	Remarks.
1.	7·00	7·22	2 hours at 50° C.
2.	3·50	4·17	2 hours at 50° C.
3.	14·00	13·90	20 hours in cold.
4.	4·08 (Crum)	(a) 3·89	2 hours at 60° C.
		(b) 4·17	24 hours in cold.
5.	3·03 (Crum)	3·00	2 hours at 60° C.
6.	5·00	4·72	24 hours in cold.
7.	10·00	7·78	24 hours in cold.
After this, zinc foil was employed.			
8.	7·00	6·95	2 hours at 60°.
9.	4·20	3·90	48 hours in cold.
10.	5·00	5·28	18 hours in cold.
11.	1·00	·95	20 hours in cold.
12.	62·26 (Crum)	43·36	40 hours in cold.
13.	62·26 „	61·81	The water was diluted to 10 times its original volume, then stood on couple 20 hours in cold.
14.	17·90 (Crum)	15·56	40 hours in cold.
15.	1·40	1·44	2 hours at 55°—60° C.
16.	4·20	4·17	2 hours at 55°—60° C.
17.	5·18 (Crum)	5·45	1½ hours at 60° C.
18.	1·44 (Crum)	1·44	1½ hours at 60° C.
19.	5·97 (Crum)	6·20	1½ hours at 60° C.

In experiments 8 to 14 the quantity of oxalic acid varied from 0·5 to 1·0 gram; and in the last 5 experiments it was 0·5 gram.

In conclusion. I wish to record my obligations to Dr. Graham, in whose laboratory these experiments were made.

MILK ANALYSIS IN BOSTON, U.S.A.

In connection with extracts from Dr. Bell's new book on Milk Analysis, &c., printed on another page, the following analyses made during one year, by the Analyst of Boston, will, no doubt, be of interest to our readers, as showing the standard adopted in that city.

MILK ANALYSES MADE DURING THE YEAR.

No.	Gravity.	Cream per cent.	Total solids	Fatty matter.	Solids not fat	Water.	Per cent. of water added.
1	1·028	1½	9·20	0·42	8·78	90·80	15
2	„	3½	7·85	0·98	6·87	92·15	35
3	„	5	10·50	1·45	9·05	89·50	20
4	„	8	12·80	2·15	10·65	87·20	
5	„	2	7·42	0·58	6·84	92·58	40
6	„	4·5	11·15	1·46	9·69	88·85	15
7	„	4	9·50	1·32	8·18	90·50	25
8	„	4·5	11·20	1·68	9·52	88·80	15
9	„	7	10·98	2·15	8·83	89·02	15
10	„	5	10·25	1·65	8·60	89·75	20
11	„	7	11·15	2·15	9·00	88·85	15
12	„	7·5	13·70	2·18	11·52	86·30	pure.
13	„	6	10·25	1·92	8·83	89·75	20
14	„	4	10·87	1·80	9·07	89·13	16
15	„	5	10·40	1·58	8·82	89·60	20
16	„	7	10·60	1·95	8·65	89·40	20
17	„	9	10·45	2·65	7·80	89·55	20
18	„	6·5	10·40	1·82	8·58	89·60	20
19	„	7	11·05	2·19	8·86	88·95	15

FOOD ADULTERATION IN FRANCE.

The following Analyses were made at the Paris Municipal Chemical Laboratory, during the month of June, 1883:—

Nature of the Samples Analysed.	Good.	Passable.	Bad.		Totals.
			Not Injurious.	Injurious.	
Wines	71	57	412	13	553
Vinegars	1	3	1	—	5
Beers	16	—	2	3	21
Ciders	—	1	5	—	6
Alcohols and Liqueurs	—	2	—	12	14
Syrups	1	—	—	—	1
Waters	15	3	2	21	41
Milks	44	173	197	—	414
Malt	—	—	—	—	—
Butters	15	—	2	—	17
Oils	3	1	4	—	8
Flours	5	—	8	—	13
Dough, Bread	1	1	—	1	3
Sweetmeats	—	—	—	1	1
Meats	—	—	1	—	1
Preserves	3	—	—	2	5
Salt, Pepper	5	—	13	—	18
Chicory, Coffee, Tea	—	2	—	—	2
Chocolates	1	—	7	—	8
Honeys	—	—	—	—	—
Confitures	—	—	—	—	—
Colouring Materials	2	2	—	5	9
Toys	—	—	—	7	7
Coloured Papers	—	—	—	—	—
Tins	2	—	1	—	3
Spices	8	—	—	—	8
Pharmaceutical Products	—	—	—	—	—
Perfumery	5	—	—	—	5
Various	22	2	8	11	43
TOTAL	220	247	663	76	1,206

THE BUTTER AND CHEESE LAW IN THE UNITED STATES.

As our readers may not have seen the law of Boston, which specially relates to these articles, we print it below:—

[CHAP. 292, ACTS OF 1881.]

AN ACT to prevent Deception in Sales of Butter and Cheese.

Be it enacted, &c., as follows:—

SECTION 1. Whoever, by himself or his agents, shall sell, expose for sale, or have in his possession with intent to sell, any article, substance or compound, made in imitation or semblance of butter or as a substitute for butter, and not made exclusively and wholly of milk or cream, or containing any fats, oils, or grease not produced from milk or cream, shall have the words "adulterated butter;" or if such substitute is the compound known as oleomargarine, then the word "oleomargarine," stamped, labelled, or marked, in printed letters of plain Roman type not less than one inch in length, so that said word cannot be easily defaced, upon the top and side of every tub, firkin, box, or package containing any of said article, substance, or compound. And in case of retail sales of any of said article, substance, or compound not in the original packages, the seller, by himself or his agents, shall attach to each package so sold at retail, and delivered with said package to the purchaser, a label or wrapper bearing in a conspicuous place upon the outside of said package the words "adulterated butter," or the word "oleomargarine," as herein provided, in printed letters of plain Roman type not less than one-half inch in length.

SECT. 2. Whoever, by himself or his agents, shall sell, expose for sale, or have in his possession with intent to sell, any article, substance, or compound, made in imitation or semblance of cheese, or as a substitute for cheese, and not made exclusively and wholly of milk or cream, or containing any fats, oils, or grease not produced from milk or cream, shall have the word "imitation cheese," stamped, labelled, or marked in printed letters of plain Roman type not less than one inch in length, so that said words cannot be easily defaced, upon the side of every cheese cloth or band around the same, and upon the top and side of every tub, firkin, box, or package containing any of said article, substance, or compound. And in case of retail sales of any of said article, substance, or compound not in the original packages, the seller, by himself or his agents, shall attach to each package so sold at retail, and deliver with said package to the purchaser, a label or wrapper bearing in a conspicuous place upon the outside of said package the words "imitation cheese," in printed letters of plain Roman type not less than one-half inch in length.

SECT. 3. Whoever sells, exposes for sale, or has in his possession with intent to sell any article, substance, or compound, made in imitation or semblance of butter, or as a substitute for butter, except as provided in section one; whoever sells, exposes, for sale, or has in his possession with intent to sell, any article, substance, or compound made in imitation or semblance of cheese, or as a substitute for cheese, except as provided in section two, and whoever shall deface, erase, cancel, or remove any mark, stamp, brand, label, or wrapper provided for by this act, or change the contents of any box, tub, article, or package marked, stamped, or labelled as aforesaid, with intent to deceive as to the contents of said box, tub, article, or package, shall for every such offence forfeit and pay a fine of one hundred dollars, and for a second and each subsequent offence a fine of two hundred dollars, to be recovered with costs in any court of this Commonwealth of competent jurisdiction; and any fine paid shall go to the city or town where the offence was committed.

SECT. 4. It shall be the duty of every inspector of milk to institute complaint for violating the provisions of this act whenever he has reasonable cause for suspicion, and on the information of any person who shall lay before him satisfactory evidence on which to sustain the same. It shall be the duty of said inspector to take specimens of suspected butter or cheese, and cause the same to be analyzed or otherwise satisfactorily tested, the result of which he shall record and preserve as evidence; and a certificate of such result, sworn to by the analyzer, shall be admitted in evidence in all prosecutions under this act. The expense of such analysis or test, not exceeding twenty dollars in any one case, may be included in the costs of prosecution.

SECT. 5. For the purposes of this act the terms "butter" and "cheese" shall be understood to mean the products usually known by these names, and which are manufactured exclusively from milk or cream, or both, with salt and rennet, and with or without coloring matter.

SECT. 6. All acts and parts of acts inconsistent herewith are hereby repealed.

PLASTER OF PARIS IN FLOUR.—If we may believe the following; the adulteration law of Germany, stringent as it is, is not strong enough to prevent such adulterations as we in England, at least of late years, never meet with:—"Dr. Skalweit, the analyst of the Local Board of Health of Hanover, Germany, had occasion recently to examine two samples of flour. He found one to contain 7½ per cent. and the other 12½ per cent. of plaster of Paris. The miller has been arrested."—*Miller.*

ERRATUM.—In the ANALYST of June, 1883, page 103, line 21 from top, *insert* the words "*less than*" before "1·8 per cent."

THE ANALYSIS AND ADULTERATION OF FOODS.

By James Bell, Ph. D., &c., Principal of the Somerset House Laboratory.

Part II.—Published for the Committee of Council on Education by Chapman & Hall.

Instead of reviewing this book at present, we reprint from it for the information of Public Analysts, the description of some of the processes used in the Somerset House Laboratory in the analysis of milk, and especially the description of the process which is carried out there for the analysis of sour milk.

Total Solids.—The determination of the total solid matter in fresh milk is a comparatively easy operation. Five grams of the milk are weighed in an accurately tared platinum capsule, which is placed on an aperture of a water-bath and at the end of about three hours, or less, when the residue is sufficiently dry, the capsule is removed to a water-oven to complete the drying. The capsule is afterwards weighed at intervals till a constant weight is obtained. It is important that the bottom of the capsule should be flat, or nearly so, and that the size should be such that, after the whole of the water has evaporated, the dry residue will be left in the form of a thin film.

It has sometimes been recommended, in order to facilitate perfect drying, that a known quantity of sand or pulverized glass should be added to the milk in the capsule; but this, according to our experience, is unnecessary, if care is taken to employ a capsule of the description mentioned.

Non-fatty Solids and Fat.—When the milk is fresh, a quantity of exactly 10 grams may be weighed in a platinum capsule containing a glass stirrer. The most suitable size of the capsule for this purpose is one having a diameter of 3 inches and a depth of 1 inch. The capsule is placed on an aperture of a water-bath, and its contents evaporated almost to dryness. It is of advantage to keep the milk well stirred during the process of drying, in order to insure that the solid residue be obtained in a condition favourable for the complete extraction of the fat. The milk residue should neither be too moist nor too dry, as either condition tends to prevent the removal of the last traces of fat. If the evaporation has been carried too far, the residue may be carefully moistened either with a very small quantity of water, or of alcohol. When the proper point has been reached, the mass is treated repeatedly with ether, the stirrer being each time used to pulverize the solid matter which, in order to insure that no portion escapes the action of the solvent, should assume a fine state of division. The ether is used warm for the last three treatments. After each washing the ethereal solution of the fat is carefully poured off through a small Swedish filter not exceeding 3½ inches in diameter. To remove the last traces of fat from the filter, the upper part is cut off, divided into small pieces, which are placed in the remaining portion of the filter in the funnel, and washed with a little ether. The filtrates are received into a tared beaker from which the ether is gently evaporated, and the fatty residue finally dried in a water-oven until the weight is constant.

The capsule containing the non-fatty residue is placed on the open water-bath for two hours, and subsequently for two or more hours in a closed water-oven kept at 212°F. (100°C.), until a constant weight is arrived at. This result should be obtained in the time stated if the milk solids have been finely pulverised in the process of fat extraction.

The determination of the fat, non-fatty solids and ash, should be made in duplicate; and, as a further check on the analysis, the total amount of milk solids may be ascertained in a third portion of the milk, which may afterwards be used for one of the determinations of the ash. It ought to be observed that, for some reason, probably connected in some way with the presence of fat, the final weighing of the total solids is seldom, if ever, so satisfactory as that of the non-fatty solids. In no case, therefore, would we advise that the non-fatty solids should be determined by deducting the weight of fat actually obtained from that of the total solids.

ANALYSIS OF SOUR MILK.

It not unfrequently happens that an analysis has to be made of samples of milk which have been kept for some time—that is, for a period of from two or three days to about four weeks—during which time the milk has become sour and coagulated. In such cases a slight diminution in the non-fatty solids will have taken place, as the result of an incipient form of fermentation which changes a portion of the milk-sugar chiefly into lactic acid, and, to a smaller extent, into alcohol and carbonic acid gas. It is, no doubt, owing to the formation of a little alcohol that the depreciation of the non-fatty solids is due, as milk-sugar changes into lactic acid practically without any loss of weight; and as the acid is not volatile, its weight is correctly indicated on drying the milk. But the weight of the sugar decomposed by alcoholic fermentation is almost entirely lost, as the alcohol disappears on evaporation, and only the small portion of carbonic acid gas which is held in solution in the milk is retained on neutralizing the milk as after-mentioned. It is evident, therefore, that some allowance should be made for decomposition in the way of addition to the amount of non-fatty solids, according to the time the milk has been kept, in order to obtain a correct estimate of the composition of the milk before any change had taken place.

It has been alleged that the fat in sour milk increases at the expense of the albuminous matter; but the results of our investigation show that the statement is without foundation. It is not unusual to obtain from sour milk about ·05 per cent. of fat more than from the same milk in the fresh state, but this arises partly from the fact that, owing to the diminution of the non-fatty solids, 100 parts of the decomposed milk represent rather more than 100 parts of the milk in its original state, and partly from the greater ease with which the residue from neutralized sour milk can be brought into a fine state of division, thus enabling the ether to act more effectively in dissolving out the last trace of fat.

In estimating the non-fatty solids and fat in sour milks, it becomes necessary to adopt a modification of the process given for the analysis of fresh milk, as the lactic acid is soluble in ether, and would be found along with, and increase the weight of, the fat; and for the further reason that it is almost impossible to satisfactorily dry the milk in the presence of the free acid, without producing a serious loss in weight from decomposition. The following method has been found to give very accurate results

Three suitable platinum capsules, two of which are supplied with glass-rods flattened at the ends, are weighed, and from 10 to 12 grams of sour milk, which has been thoroughly mixed by being whisked for a few minutes with a loose coil of fine brass wire, are introduced into each capsule, and the weight immediately ascertained. The separate quantities are exactly neutralised with pure decinormal soda solution, and the number of cubic centimetres required noted against each quantity. The contents of the two capsules containing the glass-rods are evaporated nearly to dryness, or until the residue attains the condition of a firm paste, a result which is promoted by occasionally stirring the contents towards the end of the evaporation.

The third portion is brought to complete dryness, and the amount of total solids and ash estimated.

The fat is extracted with ether in the usual way, and the non-fatty solids brought to complete dryness on the water-bath. On evaporation of the ether from the extracted fat no traces of any of the milk solids will be found in the fat, if the neutralization of the milk has been properly effected. When the weights of the non-fatty solids have been ascertained, a deduction must be made for the added soda solution. The increase of weight arising from the soda is shown in the following equation:

$$\begin{array}{l}C_3H_6O_3 \;+ NaHO = C_3H_5NaO_3 \;+ OH_2\\ \text{Lactic acid} + \text{Soda} \;= \text{Sodic lactate} + \text{Water.}\end{array}$$

Every unit, therefore, of acid is increased by one unit of sodium, less the weight of an atom of hydrogen, which it replaces in the acid. This, reckoned according to the atomic weights, is equal to 22. When, therefore, decinormal soda is used to neutralize the acid milk, every cubic centimetre used will add ·0022 gram to the milk solids, and this weight multiplied into the total cubic centimetres used will give the amount to be deducted. A similar deduction is also made in the case of the total solids. The deduction to be made from the ash is in accordance with the fact that the soda added is converted into carbonate of soda on ignition of the milk residue, and the factor for multiplying into the number of cubic centimetres of soda employed is therefore ·0053 gramme. The following actual experiment will illustrate the method:

Milk taken for total solids = 9·517 grams.

7·0 c.c. $\frac{N}{10}$ soda-solution required to neutralize ∴ 7·0 × ·0022 = ·0154 grams.

Weight of dry total solids	= 1·1390 grams.
Deduct	·0154 „
Milk solids	1·1236 „

$$\frac{1\cdot1236}{9\cdot517} \times 100 = 11\cdot80 \text{ per cent. total solids.}$$

Milk taken for Solids not Fat.

First Experiment.		*Second Experiment.*	
Milk	= 8·223 gms.	Milk	= 8·728 gms.
Soda solution required ..	= 6·000 c.c.	Soda solution required ..	= 6·40 c.c.
Dry residue	= ·720 gm.	Dry residue	= ·765 gm.
Deduct 6·0 × ·0022 ..	= ·0132 „	Deduct 6·4 × 0022 ..	= ·01408 „
	·7068 „		·75092 „
$\frac{\cdot7068 \times 100}{8\cdot223}$	= 8·59 per cent. of non-fatty solids.	$\frac{\cdot75092 \times 100}{8\cdot728}$	= 8·60 per cent. of non-fatty solids.
Dry fat ..	= ·267 gm.	Dry fat ..	= ·285 gm.
$\frac{\cdot267 \times 100}{8\cdot223}$	= 3·24 per cent. of fat.	$\frac{\cdot285 \times 100}{8\cdot728}$	= 3·26 per cent. of fat.

Ash residue	= 0·110 grams.
Deduct 7·0 × ·0053	= ·0371 „
	·0729 „

$$\frac{\cdot0729 \times 100}{9\cdot517} = \cdot76 \text{ per cent. of ash.}$$

The chlorine in the ash is estimated with $\frac{N}{10}$ silver-nitrate.

Required 3·0 c.c. to precipitate the Cl. $\frac{\cdot00355 \times 3\cdot0 \times 100}{9\cdot517} = \cdot11$ per cent. chlorine.

It is impracticable accurately to estimate the non-fatty solids by first taking the weight of the dry total solids and deducting the weight of fat obtained from it, as it is difficult to get a constant weight for the dry solids when the fat has not been removed. It is necessary, therefore, to rely on the actual weight of the non-fatty solids, as these readily attain a constant weight without any sensible decomposition.

The allowance to be made for the loss which takes place in the non-fatty solids of milk is based upon the actual loss which has been found to occur in numerous samples of milk which have been analysed in a fresh state, and again at intervals, after the lapse of a certain number of days.

The depreciation or loss is fairly uniform for the same period of the year. but the amount varies within certain limits with the ordinary atmospheric changes of temperature, a slightly increased rate of depreciation occurring on a rise of temperature. The loss of non-fatty solids is relatively greatest during the first week of keeping, the amount for that period being on the average ·24 per cent.; for the second week the loss averages ·10 per cent. additional; and for each day thereafter ·01 per cent. According to this rate of allowance, the addition to be made to the non-fatty solids would be as follows for the number of days stated:

7 days	.. ..	·24 per cent.
14 „	.. ..	·34 „
21 „	.. ..	·41 „
28 „	.. ..	·48 „
35 „	.. ..	·55 „

As already mentioned, a slight variation from these figures will be found, according to the conditions under which the milk has been kept; but the difference, whether greater or less, is generally indicated by the acidity of the milk, reckoned as lactic acid. With a carefully conducted analysis in the manner above described, the error, if any, in making the allowance should not exceed 10 per cent. of the non-fatty solids, and, in the case of watered milk, the result should come within one per cent. of the quantity of water added, as previously estimated from the analysis of fresh milk.

In the experiments upon the results of which these allowances are founded, the milk was kept in bottles filled to the extent of about three parts, securely corked, and maintained at such temperatures as might be ordinarily expected to apply to official samples retained for reference under the Sale of Food and Drugs Act.

Some tables of analyses of samples from individual cows and from dairies are given, and the author says: It will be seen from Table V. that in the case of individual cows the non-fatty solids vary from 8·00 to 11·27, the fat from 1·92 to 6·87, and the ash from ·62 to ·87 per cent., while in the case of dairy samples in Table VI., the non-fatty solids vary from 8·50 to 9·91, the fat from 2·95 to 5·14, and the ash from ·63 to ·78 per cent. The percentage of chlorine in the samples taken as a whole varies from ·08 to ·14 per cent.

Although these variations are considerable, it cannot be affirmed that they cover every case of low non-fatty solids which is occasionally met with in the milk of an individual cow.

REVIEWS.

A Manual of Chemical Analysis as applied to the Examination of Medicinal Chemicals.

By Frederick Hoffman, M.A., Ph.D., and Frederick B. Power, Ph.D.

London : Churchill.

This is the third edition of a work which has become a standard one in America, and is corrected so as to contain all the recent additions both to the American and German Pharmacopœias. It opens with a short description of general qualitative analysis, giving the usual courses for bases and acids, of which the former is the best, that for acids having the too common fault of a certain degree of vagueness. It has always struck us as strange that, among the immense mass of books treating of qualitative analysis, there are so few where a really definite systematic course for acids is clearly laid down, and yet in the hands of any practised analyst, such a course is really as well defined as the base one. Following this we have a treatise on volumetric analysis taking in acidimetry and alkalimetry; analysis by oxidation and reduction, with solutions of potassium permanganate, potassium bichromate, iodine and sodium thiosulphate; estimation of sugar and precipitation by argentic nitrate. This chapter is well and concisely written, and includes a plain statement of the short method of calculation by equivalents used by practical men. Then follows a chapter on alkaloids and their separation by the Stas-Otto method. The various chemicals are then taken in alphabetical order, beginning with *acetum* and ending with *zinc valerianate*, and under each is given, (1) a description of the article, (2) a qualitative examination for impurities, and (3) a quantitative test. In these the lines of the various pharmacopœias are chiefly followed, but frequently we find methods, especially quantitative, not usually given, and decidedly good and simple. Of course, a critical reader will every now and then be struck by an omission, such as, for instance, no mention of any other method of estimation of free sulphuric acid in vinegar than the old pharmacopœia idea of direct precipitation with barium chloride, and an allowance for possible sulphates in the water, altogether ignoring the modern method described some years ago in The Analyst by Mr. Hehner. Then, again, in following the various official methods for bark analysis given by the authors, any analyst would find quinine makers very loth to buy on his results. Taken, however, as a whole, the work is one which should have a place on the shelves of every Public Analyst as a very useful book of reference, and it would be all the more useful to us in England if we only had definite legal standards laid down for the purity of medicinal chemicals.

Elements of Pharmacy, Materia Medica, and Therapeutics.

By William Whitla, M.D.

This is an addition to the series of Medical Students' Manuals, published by Mr. Renshaw, and we may say at once that for the purposes intended it is a useful one. It commences with about 45 pages devoted to the instruction of the student in practical pharmacy and dispensing, which, although not sufficiently exhaustive to be of any real use to pharmacists, will yet be very serviceable to medical students, who, as a rule, are exceedingly deficient in this art. Following the general introduction we have a similar number of pages devoted to the ingredients and strengths of the various preparations found in the *British Pharmacopœia*, and tabulated for ready learning. As a whole, this part is fairly correct, but we notice in glancing through it several slips requiring correction in future editions (such as the strength of *Mistura Gentianæ*). Leaving the pharmacy, the author then takes up materia medica, and here the whole of the usual and many of the rarer drugs and chemicals used in medicine are taken alphabetically, their names, orders, habitats, preparations, and doses are given, but only in rare instances their exact composition. One of the few cases where the author ventures to give figures, is in the case of Kino, which we are told contains from 70 to 80 per cent. of tannin, a statement calculated to somewhat astonish analysts having much to do with astringents. So long as the book is strictly in its own line it is all right, but where the necessities of the work cause the author to touch on the allied sciences of botany and chemistry, then there comes a difficulty now and then. For example, on page 137 we read " COLCHICI CORMUS (Colchicum *Corm*)—Melanthaceæ. The fresh *bulb* about the size of a chestnut of " &c., &c. The italics are ours, and unless botany has very much altered, it used (in our student's days) to be one of the very first things to learn how to distinguish a bulb from a corm. Taking next page 119, we find it stated that, in making *Berberiæ sulphas*, the slaked lime is used to precipitate the alkaloid, while we have always viewed it as being employed to remove the excess of sulphuric acid, the alkaloid being subsequently thrown down by the ammonium hydrate. On page 157 there is a note, which would lead to a wrong chemical belief in the mind of a too confiding student, because we read that as mercuric chloride is decomposed by so many substances it is advisable to order it in plain solution, or in solution with iodide of potassium, thus leading to the inference that no chemical decomposition takes place when mercuric chloride is mixed with potassium iodide. Having thus pointed out a few things that at once appeared undesirable, let us now hasten to the final portion of the work, viz.: about 200 pages of therapeutics. Here, in our opinion, the author is quite at home, and we have rarely met with so complete and yet concise treatment of this important subject. Taken as a whole, we have no doubt that Dr. Whitla's work will become exceedingly and deservedly popular among medical students preparing for examination, for whose use it is specially suitable, but to those seeking such information as to the exact chemical constitution of drugs, and the tests for the presence of their active constituents, as is usually included in all works on materia medica, it is a barren soil, and, therefore not sufficiently deep in this respect for the use of analytical or pharmaceutical students.

Reports of Trials for Murder by Poisoning, with Chemical Introduction, and Notes on the Poisons used.

BY G. LATHOM BROWNE, Barrister-at-Law, and C. G. STEWART, St. Thomas' Hospital.
London: Stevens & Sons, Chancery Lane.

IN the old original days of the Polytechnic and Mechanics' Institutions', the union of chemistry and sensation used to be very popular, but when the science and art teaching came to be general, the sensation element died out, and the hard and dry facts of chemistry remained. Here, however, we have probably one of the most startling combinations of science and sensation ever put together in one volume. The poisons treated of are Hydrocyanic Acid, Strychnia, Antimony, Arsenic, and Aconite, and their use, or rather abuse, is illustrated by full reports of the famous trials in which they have figured.

Commencing with the almost forgotten trial of Tawell, the Quaker, for poisoning his mistress with prussic acid, attention is at once arrested, and the chemist reads with deep interest the evidence of the experts of that day, and how, with their imperfect apparatus and methods they built up the evidence. Then comes the evidence for the defence, that the hydrocyanic acid might have been taken unconsciously in the form of apple pips, and especially that of the scientific shopman at a chemist's in the city, who was called to swear that from the pips of 15 small apples he extracted sufficient prussic acid to produce two grains and a quarter of argentic cyanide; the process being described as being that of "a soft water bath, diluted sulphuric acid, and sulphate of iron." But all this was in vain, and Mr. Tawell came to his deserved fate, having previously confessed his misdeeds, and proved the accuracy of the evidence for the prosecution. After two or three minor cases, we come to strychnia and Palmer with the evidence of Drs. Taylor and Christison; to arsenic and Madeline Smith with the evidence of Professors Penny and Christison for the prosecution and Maclagan for the defence; to antimony and Pritchard; and lastly to aconite and Lamson with the evidence of Drs. Dupré and Stevenson. Each case is first carefully detailed by Mr. Browne, and then Mr. Stewart takes up the story and chemically criticises the scientific evidence, showing the advantages or otherwise of the processes employed, and bringing to light many special experiments bearing on the matter which he has made. A captious critic might here and there find a few faults of omission, but very few of commission in Mr. Stewart's part of the book. For instance, in the table of distinctions between morphia and strychnia by first adding sulphuric acid and then certain other reagents, such as potassium bichromate, &c., there is no mention of the beautiful reaction with molybdate, so characteristic of morphia. Setting aside such few points however, Mr. Stewart must be highly complimented on the very painstaking manner in which he has done his part, and the whole work forms exceedingly interesting reading to all interested in toxicology and forensic medicine. As a guide to barristers anxious to post themselves up in points to ask, and to scientific witnesses to see the possible pitfalls to avoid, it will be invaluable.

BIRMINGHAM AND ADULTERATION.

Dr. Alfred Hill, Analyst for the Borough of Birmingham, reports that during 1882 he examined 321 samples, including 101 milks, 75 mustards, 43 coffees, 40 peppers, 30 flours, 6 bread, 12 teas, 4 butters, &c. Dr. Hill says that 58 of the samples purchased, or 18 per cent. were found to be more or less adulterated; it is gratifying, however, to find that during the past ten years the proportion of genuine articles continues to increase, being this year 82 per cent., against only 35 per cent. in 1873, and greater than in any other year of the decade.

The percentage of adulteration in Milk continues to decline, and now stands at 36 per cent., or less than half what it was in 1873, when it was 75 per cent. Of the 101 samples bought during 1882, 36 had been tampered with, either by the addition of water, or the abstraction of cream, or by a combination of both methods of falsification.

Birmingham has had, for a long time, the unenviable distinction of exceeding all the large towns in the extent of its milk adulteration; it is, therefore, all the more satisfactory to find an improvement in this direction. During the last ten years the amount of adulteration has never been so low as in 1882, except in the year 1876. The immense importance of milk as an article of diet, for children and invalids especially, renders it imperative on the authorities to make every effort to secure its purity.

Of the 75 Mustards, 6 proved on analysis to contain an admixture of wheaten flour and turmeric, while 15 or 48 per cent. of the Coffees contained large quantities of chicory; in several instances the vendors of the latter article had protected themselves by labelling the article a "Mixture."

One of the Butters examined was such only in name, and consisted entirely of Butterine, though sold as Butter. The other samples were quite genuine.

The Teas all proved to be genuine, indeed so careful a supervision of the article at the ports of entry is exercised by the Government that it is difficult to obtain adulterated samples from the retail dealer.

Bread and Flour also held, as usual, a distinguished place among the other articles of food. It is a fact, as gratifying as remarkable, that I have not met with an adulterated sample of either the one or the other during the last ten years. The pleasure of recording it is enhanced, when it is considered how important is the quality of the most universal of all foods in reference to the well-being of the great mass of the people, constituting for them, as it actually does, the staple of their daily food, and indeed the veritable "staff of life." If it be possible to carry on so extended a business as that of a Baker or a Miller at once honestly and profitably, it is difficult to see any reason why the Milkman or any other purveyor of food should not transact his business on the same lines.

PUBLIC ANALYSTS' REPORTS.

Dr. H. J. Alford, the Analyst for Somersetshire, reported at the Quarter Session held at Taunton, that during the quarter he had analysed 266 samples of food and drugs, among which were 50 of dairy produce, including 15 specimens of butter. Of groceries he had tested 158 samples, viz.: 49 of tea, 9 of sugar, 15 of arrowroot, 9 of sago, 3 of tapioca, 27 of pepper, 26 of mustard, 16 of coffee, and 4 of corn-flour. Of the various samples, he found 3 of mustard, and 3 of coffee adulterated; but he added to his report that none of the adulterations were absolutely injurious to health.

At Wiltshire Quarter Session the County Analyst reported that among other samples he had analysed a sample of salt butter forwarded from Marlborough, two samples from Malmesbury, and samples of butter and coffee from Trowbridge, all of which were genuine.

At Berkshire Quarter Session the Public Analyst reported he had examined 21 samples of coffee, butter, mustard, and lard, 8 of which were not genuine.

The *Grocer* says that the mention of the Analyst's report at the Hereford Quarter Session generally provokes laughter in the court, and at the last sitting of the Court, the Chairman (Sir Richard Harrington) said he believed the report of the Analyst was not *nil* this time. This was received with merriment. The Clerk of the Peace stated that the Analyst had reported that no samples had been submitted to him during the quarter.

A similar state of things prevailed in Breconshire at the Quarter Session, the Public Analyst reporting that he had during the past three months received no samples of food, drink, or drugs, for analysis.

The Cheshire County Analyst reporting to the Court of Quarter Session, stated, that during the past quarter he had examined, amongst other samples forwarded to him, 9 peppers, 8 mustards, 7 coffees, 6 teas, 7 lards, and 5 butters. Of these, 4 coffees, 2 peppers, and 1 mustard were adulterated.

CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

THE MILK CASE AT MANCHESTER.

To the Editor of "The Analyst."

Sir,—Please kindly correct the figure given in my letter in the July number as non-fatty solids of farmer's milk. The figure should be 9·3 not 9·6.

Yours, &c.,

C. ESTCOURT.

LAW REPORTS.

Copperas in the Pickle-jar:—

The Court of Appeal in Brussels has just decided that the objection to pickles, artificially coloured green by the contact of the vinegar with copper utensils, is a mere prejudice. Some manufacturers of pickled gherkins in that city having been condemned in December last to a fine, for having in the technical language of the judgment "sold or exposed for sale certain substances affected by copper verdigris, of a nature to cause the death of the consumer, or at least to produce effects injurious to health," one of the condemned appealed, and the case has necessitated the examination of scientific witnesses, and the hearing of arguments from eminent counsel on both sides. On the part of the prosecution, M. Depaire, ex-Professor of Chemistry in the University of Brussels, deposed that salts of copper are unquestionably poisons. For the appellants, however, M. Dumoulin, Professor of Chemistry in the University of Ghent, declared with no less confidence that such salts are "incapable of doing any harm." This witness even stated that so certain was he on this point that he himself, as well as his wife and children, had taken a strong dose; but that so far from being unwell they had felt better for the experiment. M. Dumoulin's emphatic assertion that the "sels de cuivre" had been "calumniated by science" is stated to have caused a strong sensation among the parties interested in court. Finally judgment, free of costs, was given for the appellant.—*Daily News, May 9th.*

At the Stone Police Court, recently, George Yeomans, manager of the branch shop in High Street, Stone, of Mr. Bennion, grocer, of Wolverhampton, was summoned for having sold as genuine butter a substitute known as butterine. Major Knight, inspector under the Food and Drugs Act, conducted the case for the prosecution; Mr. Welch appeared for the defendant. A young woman named Alice Johnson stated that on the 8th ult. she purchased at the shop a pound of the substance in question as butter, which was sold at 9d. per pound. Having given the assistant formal notice of having bought it for the purpose of its being analysed by the County Analyst, she divided it into three parts, and these she sealed up, and left one portion with the assistant and handed the other two over to Major Knight, under whose directions she had been acting. In answer to Mr. Welch, the witness said that on going into the shop she inquired the prices of butter, and was told various prices down to 9d. She pointed to a quantity of something to all appearance butter in the window, and asked the price of that. She was told it was 9d., and she said she would take a pound of it. Major Knight deposed to having received the two sealed samples of the compound from the witness, and to having forwarded one of them to the County Analyst. He put in the report received in reply, which certified the article to be butterine —a mixture of animal fats. The compound contained no deleterious matter, but was not butter. The girl was recalled by the Bench, and said that there was nothing but the price ticket on the butterine. For the defence, Mr. Welch admitted the compound to be butterine, but contended that no attempt had been made to disguise its nature. He handed in a bill, in which the respective prices of the various "butters" were enumerated, the article in question being called butterine, and figured at 9d. per pound. These bills were exhibited in the window and in the shop, and the girl had every facility for knowing the nature of the article she was buying. He submitted that the 6th section of the Food and Drugs Act, under which the charge was brought, required a specific article to be asked for, whereas the girl had simply pointed to the butterine, saying she would take some of that. It should not have been analysed as butter but as butterine, as which it would have been found genuine. Mr. Locker said if it could be proved that a bill like the one handed to the Bench had been exhibited within view of customers at the shop the case must fall. The Bench again called the girl, who denied having seen such a bill, and added that after she had been served with the butterine the defendant, who had been temporarily absent, asked the assistant whether he had sold the butterine as butter, and the assistant replied that he had. The Bench said they thought it would have been better for the butterine to have been properly ticketed, so that no room could exist for misapprehension as to its character. They felt bound to convict in the present case, and a fine of 1/0 and costs would be inflicted.

Farmers and Consignees of Milk.—Samples taken at the Station:—

At the County Police Court, Manchester, before Sir John Iles Mantell and Captain Aitken, Peter Reed, a farmer at Alderley, was summoned by Superintendent Bent for a breach of the Adulteration Act.—Mr. W. Cobbett defended.—Mr. Crofton said the defendant was under a contract to deliver milk at Longsight Station to James Brocklehurst, of Mornington Street, Chorlton-upon-Medlock, and on the

9th of March Mr. Bent took a sample of this milk at the station. This had been analysed, and was declared to contain 27 per cent. of added water.—James Brocklehurst was sworn, and said his contract with the defendant was for new milk. When Mr. Bent took the sample, he did not say he was going to have it analysed.—Mr. Bent having proved the taking of the sample, and produced the analyst's certificate, said, in answer to Mr. Cobbett, that he never gave the defendant any notice of what he had done, except the summons.—Mr. Cobbett submitted that there was no case, and he did so on two grounds. In the first place, the Act had not been complied with by the prosecution. The summons was taken out under the third section of the amended Act, which provided that when a sample is taken from a consignor it should be dealt with in the same manner as to notice and so forth as provided by the 14th section of the original Act, which provision had not been complied with. His second point was that his client was summoned for having sold this milk as a retailer to Mr. Bent, whereas there was no evidence of anything of the kind; he was simply the consignor of the milk. If this summons was sufficient in a case of this kind, there would have been no necessity for an amended Act.—Mr. Crofton contended that the defendant was the vendor, to all intents and purposes, within the meaning of the Act.—Mr. Cobbett: The charge stated in the summons is that the defendant did then and there sell a quantity of milk to Mr. Bent, when in fact he was not there at all, nor anyone on his behalf.—Sir John: From whom did you buy the milk, Mr. Bent?—Mr. Bent: From no one.—Sir John: The Act says that the milk must be "to the prejudice of the purchaser."—Mr. Cobbett: And therefore if there is no sale there is no case.—Mr. Crofton met this argument by citing the case of Rouch *v.* Hall, decided by the Queen's Bench, where it was held that the formalities as to purchase, division of the sample into three parts, and informing the offender of the object for which the sample is obtained, provided for by the 14th section, are not requisite in a case of this kind, where the milk is taken from the consignor.—Mr. Cobbett admitted that the case referred to was conclusive on those points, but said he had still to contend that the offence proved against his client was not the one for which he had been summoned. He was charged with selling the milk on the day in question, but the fact was he had sold it previously, when the contract was made.—Sir John: The delivery is part of the sale.—Mr. Cobbett contended that as soon as the milk was put on the railway at Alderley it passed out of the possession of the defendant, and the ownership was vested in the consignee.—Mr. Crofton submitted, on the other hand, that the ownership remained with the farmer until the milk had actually got into the possession of the consignee, and that it was only in process of delivery to him when the sample was taken.—Sir John said there must be a conviction, but the Bench would be glad to grant Mr. Cobbett a case for argument in the Court above if he desired it. There would be a penalty of £5 and costs.

Summons Dismissed—Decision as to Costs.—

At Brentford, on the 21st July, Mr. Edward Davis Roe, grocer, Upper Square, Isleworth, was summoned under the Food and Drugs Act for having sold mustard which was not of the nature and substance of the article demanded, the complainant being Mr. Stevens, the district inspector. The case first came before the Bench on the 7th inst., when a certificate from Dr. Redwood, the County Analyst, was put in, stating that the mustard contained 12 per cent of wheat flour. For the defence, however, Mr. F. Woodbridge called a Public Analyst for another county, who said the article was perfectly pure. The case was adjourned for the opinion of the authorities at Somerset House, who certified that the article was genuine. On the summons being dismissed, Mr. Woodbridge applied for costs, explaining that his client had had to pay a guinea for the analysis by the authorities of Somerset House, notwithstanding the strength of the evidence produced on his behalf in the first instance. The magistrates felt that as the inspector had been fortified by the certificate of the County Analyst, they could not order him to pay costs, the chairman (Mr. Glossop) remarking that if the defendant's good name was worth anything it was worth the fee he had paid.

Another Decision as to Costs of Dismissed Summons:—

Before the local magistrates, Mr. Henry Elman, grocer, London House, Sevenoaks, was summoned, on remand, for selling, to the prejudice of the purchaser, adulterated mustard, which was not of the nature and quality demanded by the purchaser, at Sevenoaks, on May 1. Mr. E. F. Knocker, the clerk of the court, said that the case was before the Bench last month, when there was a conflict of testimony—Dr. Adams, the County Analyst, certifying that the sample handed to him was adulterated with 12 per cent. of wheaten flour; and Mr. C. H. Piesse, the Analyst of the Strand Union, proving that the sample he tested was perfectly pure. He was ordered by the Bench to write to Dr. Adams, and he did so; Dr. Adams now wrote to say that he and Mr. Piesse analysed each other's samples with the same result, and they agreed to refer the matter to Mr. Otto Hehner, Secretary of the Society of Public Analysts, who corroborated their view that there was some mixture in the one sample, and not in the other. Dr. Adams, therefore, thought that the prosecution might be dropped. The third sample of the mustard was sent by Superintendent Okill, to the Government Analyst at Somerset House, and the certificate he had received stated that the sample was perfectly genuine. He had, therefore, given Mr. Elman notice that the case would be withdrawn, and that he need not bring his witnesses. Mr. L. W. Gregory, solicitor, who represented the defendant, said that if the case was to be withdrawn, the prosecutor ought to pay the costs. It seemed a strange thing that these two ounces of mustard, which were taken for analysis, were divided into three parts, and that two of them should have been proved pure, and one adulterated with 12 per cent. of wheaten flour. Unless Mr. Elman had incurred considerable expense, the certificate of the County Analyst would have been put in, and nothing could have saved him from being mulcted in a fine and costs. Mr. Knocker pointed out that Mr. Elman's own analysis proved that the sample analysed by Dr. Adams was more adulterated than the County Analyst certified for. Mr. Gregory pointed out that if the Somerset House Analyst had certified that the sample he tested had been impure, his client would have been convicted, and, therefore, when the case was dismissed, he was entitled to his costs. Unless he had been in a position to employ Mr. Piesse, which cost him five guineas, he would have been convicted. He would, therefore, urge that he ought to be allowed his costs against the county. The chairman refused the application. He said that they felt that it was a very hard case for Mr. Elman, but even his own analyst proved the sample tested by Dr. Adams was more adulterated than the County Analyst said it was.—*Grocer.*

THE MANCHESTER MILK CASE.—We understand that the Corporation has been served with a notice of appeal in this adulteration case, which we reported last month.

Commenting on the case, a correspondent of the *Cowkeeper and Dairyman's Journal* says:—"The nett result of this trial appears to me that Somerset House has failed altogether to satisfy either the authorities, the trade, or the public. The fact is, they are so very careful that no one shall be hurt or wronged by their decision that their very caution really stops the working of the Act, and throws open wide the doors that any one who feels so disposed may adulterate as he likes, and with perfect safety!!!"

MILK ADULTERATION IN NEW YORK.—The Board of Health of New York have resolved that the following section shall be added to the Sanitary Code already in force in that city:—"Section 207. Any milk found to be adulterated either by the addition of water or other substance, or by the removal of cream, or which has been brought into, or is held or offered for sale, in the city of New York, contrary to the provisions of Section 186 of the Sanitary Code, may be seized and destroyed by any inspector or other officer of this department authorised to inspect milk."

Mr. J. A. Wanklyn has been appointed Public Analyst for Peterborough, for a term of two years.

Mr. E. H. Moore has been appointed Analyst for the Eastern and Western divisions of Sussex for one year.

RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

No. 1884.	Name of Patentee.	Title of Patent.	Price.
2338	H. E. Jones	Manufacture of Animal Charcoal	6d.
2339	J. W. Ingham	Manufacture of Animal Charcoal	6d.
5078	A. F. Hills	Secondary Batteries	2d.
5142	W. R. Lake	Electric Lamps	4d
5159	J. Welter	Recovery of Tar and Ammonia from Volatile Products from Coke Furnaces	6d.
5196	J.T. Armstrong & W. Bostock	Manufacture of Soap	4d.
5230	C. Estcourt	Purification of Coal Gas	2d.
5303	E. Petri	Purifying or Disinfecting Sewage	6d.
5346	J. Jameson	Incandescent Electric Lamps	4d.
5373	J. M. Boullon & I. Probert	Electric Lamps	6d.
5390	W. R. Lake	Obtaining Zinc and Copper from Ores	8d.
5412	E. Carey & F. Hunter	Manufacture of Bisulphite of Soda	6d.
5422	H. Woodward	Electrodes for Secondary Batteries	
5466	W. P. Thompson	Making Soaps, Separating Component Parts of Fats and Oils and obtaining Glycerine, &c.	6d.
5481	A. M. Clark	Manufacture of Potash and Soda	2d.
5495	Elphinstone, Baron, & C. W. Vincent	Electric Arc Lamps	6d.
5504	A. Swan	Incandescent Electric Lamps	6d.
5509	L. A. Groth	Process for Production of Magnesium, Aluminum, &c.	2d.
5545	J. Mactear	Utilizing Bye-products of Soda and Potash Manufactures	4d.
5572	C. T Kingzett & M. Zingler	Antiseptics, Disinfectants and Deodorants	4d.
5601	A. Tribe	Secondary Batteries	4d.
5604	S. Mellor	Manufacture of Benzol, Nitro-Benzol, &c.	4d.
5607	W. Weldon	Treating Mixed Solutions of Chloride of Copper, and Sulphate of Soda	6d.
5644	J. Lea	Secondary Batteries	2d.
5692	I. Levinstein	Manufacture of Colouring Matters	2d.
5696	J. Imray	Manufacture of Colouring Matters	2d.

BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Practicien; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; A Manual of Chemical Analysis as applied to the Examination of Medicinal Chemicals; Elements of Pharmacy, Materia Medica, and Therapeutics; Reports of Trials for Murder by Poisoning, with Chemical Introduction, and Notes on the Poisons Used; Vichy and its Therapeutical Resources.

THE ANALYST.

SEPTEMBER, 1883.

MILK ANALYSIS.

Remarks by P. Vieth, Ph.D., F.C.S.

The August number of The Analyst, 1883, contains on page 138, a series of milk analyses made by the Analyst of Boston. In some introductory words it is said, "that the analyses will, no doubt, be of interest to the readers, as showing the standard adopted in that city." The figures are given without any criticism and unaccompanied by any further remark, notwithstanding that there is in my opinion a great deal to be said about them.

Taking the figures as they are, it is in the first place striking, that the specific gravity of all the nineteen samples of milk should be the same, viz. 1·028. This appears still more peculiar, if one bears in mind, that there exists a certain relation between the specific gravity and the percentage of fat and solids not fat in milk. The said relation is a fact, well established and supported through carefully executed researches and thorough investigations, carried out by different well-known chemists. The analytical figures of the Boston Analyst entirely disagree with this fact. He found, as mentioned already, that all the samples had a specific gravity of 1·028.

Sample No.	1	contained	0 42	Fat and	8·78	Solids not fat.
,,	5	,,	0·58	,,	6·84	,,
,,	2	,,	0·98	,,	6·87	,,
,,	7	,,	1·32	,,	8·18	,,
,,	3	,,	1·45	,,	9·05	,,
,,	6	,,	1·46	,,	9 69	,,
,,	15	,,	1·58	,,	8·82	,,
,,	10	,,	1·65	,,	8·60	,,
,,	8	,,	1·68	,,	9·52	,,
,,	14	,,	1·80	,,	9·07	,,
,,	18	,,	1·82	,,	8·58	,,
* ,,	13	,,	1·92	,,	8 83	,,
,,	16	,,	1 95	,,	8·65	,,
,,	4	,,	2·15	,,	10·65	,,
,,	9	,,	2·15	,,	8·83	,,
,,	11	,,	2·15	,,	9·00	,,
,,	12	,,	2·18	,,	11·52	,,
,,	19	,,	2·19	,,	8·86	,,
,,	17	,,	2·65	,,	7·80	,,

How it is possible, that two milks of the same specific gravity, and containing the same or very nearly the same amount of Fat, should contain so different a percentage of solids not fat, as in the cases of No. 1 and 5, 3 and 6, 10 and 8, 14 and 18, 4 and 9, 12 and 19, is difficult to understand.

There must be an error, Total Solids being given 10·25 per cent.

Looking over the figures for fat, we find that one sample only of the whole series of nineteen comes up to the standard adopted by the Society of Public Analysts. In five other samples fat was found to amount to over two per cent., more accurate from 2 15 to 2·19 per cent., and among these five samples are the only two of the series which are considered not to be watered, and one of which is expressly marked as "pure." There is in no case any remark made as to the deprivation of cream, in spite of the fat falling down as low as 0·42 per cent. in a milk which is said to contain 15 per cent. of added water.

Fifteen per cent. seems to be the smallest amount of water which is ever added or could be detected, and I may add that this is the only systematical point I am able to see. On the other hand, I am quite at a loss to find out the system of calculating the extent of the adulteration. It is stated that 15 per cent. of added water are contained in milk samples with 8·78, 8·83, 8·86, 9·00, 9 52, 9·69 per cent. of solids not fat, 16 water by 9·07 solids not fat, 20 by 7·80, 8·58, 8·60, 8·65, 8·82, 8·83, 9·05, 25 by 8·18, 35 by 6·87 and 40 water by 6·84 solids not fat. I should be very glad to hear some explanations of these extraordinary statements.

I confine myself to what precedes and conclude these remarks, repeating that the figures relating to milk analyses made at Boston and published in The Analyst, give a great deal to think, but that they are in my opinion totally unfit to show a standard adopted.

ON THE EXAMINATION OF FATS.

By K. Zulkowsky.

Some time ago Max Groger submitted Hausemann's method of titration for mixtures of neutral fats and fatty acids to a thorough examination in the author's laboratory. He has succeeded in improving and simplifying the method to such an extent that it is now easier to determine such a fatty mixture than a mixture of caustic soda and sodium carbonate. The method is based upon the fact that a fatty acid in an alcoholic solution is immediately saponified by an alcoholic solution of potassa, whilst with neutral fats this change ensues only on prolonged boiling. If we therefore add phenol-phthaleine to the alcoholic solution of fatty acids and neutral fats, and titrate with caustic potassa, the red colour disappears instantly as long as free fatty acids are present. When these are saturated the liquid turns red. If an excess of solution of caustic potassa is added and the liquid is boiled for half-an-hour, the neutral fat is saponified, and on titrating back we find the volume of the potassa solution which has been required for saponifying the neutral fat. From the consumption of this test-liquid in the saponification of the fatty acids and of the neutral fats, their quantity can be calculated, even if the weight of the mixture is not known. This is the principle of this simple and elegant method, which, according to test-experiments, yields very accurate results.

On further consideration the author regards Hausemann's idea as a mine from which may be obtained much that will be useful in the technology of fatty matters. Several cases follow in which it gives exceedingly valuable conclusions in testing fats.

1. It is possible to ascertain the equivalent of a fat, *i.e.*, the quantity of it which is saponified by an equivalent of caustic potassa, or by a litre of normal potassa. This figure gives in certain cases an indication concerning the nature of the fats. In the examination of butters the equivalent will beyond doubt show whether we have to do with a natural or a factitious butter. Whether it will be possible to detect a mixture of both with certainty must be decided by future experiments.

2. We are enabled to determine directly and in the simplest possible manner the proportion of glycerin in fats, *i.e.*, the theoretical yield of glycerin. In titrating a neutral fat or a mixture of several fats, the following reaction takes place :—

$$\underbrace{C_3H_5(O.C_nH_{2n-1}O)_3}_{\text{Neutral Fat}}+\underbrace{3KOH}_{\substack{\text{Caustic}\\ \text{Potassa.}}}=\underbrace{C_3H_8O_3}_{\text{Glycerin.}}+3(\underbrace{C_nH_{2n-1}O.OK}_{\substack{\text{Potassium Salt of a}\\ \text{Fatty Acid.}}}).$$

According to this equation, for every litre of normal potassa $\frac{1}{3}$rd of an equivalent. *i.e.*, 30·667 grms., of glycerin will be liberated, or 1 c.c. normal alkali represents 0·030667 grm. glycerin. The determination of the proportion of glycerin in fats is at present of great technical interest, as in consequence of the growing demand and the high market price the yield of glycerin cannot be left out of consideration.

3. When the proportion of glycerin has thus been established by titration if the fat is pure and free from water, the theoretical yield of fatty acids appears at once. The tri-glycerides can be regarded as decomposed as follows :—

$$\underbrace{C_3H_5(O.C_nH_{2n-1})_3}_{\text{Neutral Fat.}} = \underbrace{C_3H_2}_{\substack{\text{Glycerin}\\ \text{Residue.}}} + \underbrace{3C_nH_{2n}O_2}_{\substack{\text{Hydrated}\\ \text{Fatty Acid.}}}.$$

If we compare this equation with the former one, 1 litre normal alkali corresponds to $\frac{1}{4}$ equivalent, *i.e.*, 12·667 of the glycerin residue, C_3H_2. If v c.c. normal alkali have been consumed, the weight of the glycerin residue $(0·012667\ v) = G$, and if F grms. of the neutral fat have been weighed out $(F - G)$ is the quantity of the fatty acids.

4. If the proportion of fatty acid $(F - G)$ has been thus determined their equivalent follows. If we have used v c.c. normal alkali the equivalent results from the following proportion :—

$$(F - G) : A = v : 1000.$$

$$A = \frac{1000\ (F - G)}{v}$$

—*Berichte Deutsch. Chem. Gesell.*

In connection with the above we may call attention to the following extracts from a paper on Butter Analysis, by Mr. Wigner, read before the Society of Public Analysts in August, 1879.*

“Taking all these precautions, however, I find the process a useful one. But I must call special attention to the following exceptions:—It is comparatively useless when applied to old samples of butter, which have been alternately heated, and cooled; and, even in the cases of lard and butterine, repeated heating exercises a more uncertain effect than it does on the fatty acid determination; but, although useful, it can never come into general use as a substitute for the determinations of fatty acids and soluble acids, because any alkalies added to the fat, whether fraudulently, or for supposed preservative purposes, entirely upset the estimation. Therefore, while it may be—and in my opinion is, when properly carried out—a safe process on which to pass a butter as genuine, it is quite unreliable as a proof that the butter is adulterated. The admixture of three per cent. of carbonate of soda with the salt added to the butter, will, by this process, change the results so much, that a genuine butter would be condemned; and such a percentage of admixture is one that has been used, while smaller percentages are common.'

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* THE ANALYST, Vol. IV., p. 182.

"I have had several samples of butter apparently recently made, and, certainly, in good condition, which have required as little as 21·34, 21·36, 21·50 per cent. of KHO to saponify them, and which have yet given less than 89 per cent. of fatty acids by the flask washing process, and which, independently of the other conditions, I certainly would not condemn as adulterated. In my opinion, therefore, the titration process can only be relied on when it shows figures higher than Koettstorfer has put as the limits."

MILK AND ITS ADULTERATORS IN NEW YORK.

Numerous analyses of the milk sold in the city of New York clearly established the fact that this important article was shamefully adulterated, and that on the average at least 33 per cent. of water was added to the original milk, while a considerable part of the cream was often removed. It was also found that most of the condensed milk companies skimmed the milk before concentrating it. The total frauds of milkmen amounted to about 10,000 dols. per day. The Metropolitan Board did not attemp to grapple with this evil, but as soon as Dr. Chandler was made president of the Health Department he initiated a successful warfare upon dishonest dealers, assuming that as milk was the chief diet of the 130,000 children in New York under five years of age, it was the most important article for sanitary supervision. The milk dealers organised an association, and secured legal and chemical assistance, attacking both the law and the chemical methods employed. After several test cases had developed all the facts the Court of Appeals affirmed the laws, and the best chemists in the country endorsed the methods. About 40,000 dols. has been paid into the city treasury as fines by offending milkmen, and quite a number of them have spent from ten to ninety days in prison.—*Sanitary Engineer*.

[*Note*.—The above extract seems to show that the United States have gone far ahead of England in attempting to stop adulteration, but the profit is we fear too large for the attempt to succeed unless the fines are increased further. 40,000 dols. is a mere trifle as against the profits gained by watering and skimming milks in New York. And how about London and especially a West End district which we need not name ?—Ed. Analyst.]

ADULTERATIONS IN LARD.

An American Journal says that it is openly admitted by the lard-dealers of Chicago that all lard is adulterated from ten to fifty per cent. In all but the worst grades the adulteration is harmless, being oleomargarine, cotton-seed oil, vegetable oils, and tallow.—[We doubt this statement.—Ed. Analyst.]

ADULTERATED TEAS IN AMERICA.

In his decision, on the motion to continue the injunction restraining the sale of the Pingsuey teas, Judge Freedman suggests that the parties agree to have an immediate trial by referee, since there is such a conflict of evidence in regard to disputed questions of fact that they cannot well be determined upon affidavits. If they do not adopt the suggestion, he will order a reference to determine whether the teas are unwholesome by reason of adulteration.

About two thousand packages of Pingsuey teas were recently seized by a Custom House officer of this port, under the new United States law to prevent the importation of adulterated teas. They were consigned to a Boston firm, who appealed from the custom officer's decision, and the matter was referred to a board of arbitration consisting of one member chosen by the Collector, one by the merchants, and a third by the first two. Their report sustains the action of the appraiser.—*Sanitary Engineer.*

Under the operation of a new law against the importation of impure teas, more than 8,000 packages of tea brought from Shanghai, China, and valued in the market, if sold, at 20,000 dols., were condemned recently by the appraiser at the port of New York. The teas were mixed with sand and gravel, exhausted tea leaves, and dirt and paste rolled into pellets to represent dried leaves. In several instances the impurities were evident to an inexperienced observer. When taken in the hand and crushed between the fingers, the sand was plainly visible.

About 500 packages of colored Japan tea, of which a greater portion was dust, were also rejected after a careful examination. This tea was of high color and mixed with mineral substances to increase the weight.—*Scientific American.*

OFFICIAL FEES FOR ANALYSES IN GERMANY.

The Berlin police pay for chemical investigation of the following substances the rates quoted below, namely:—Six marks for butter; 3 marks for tea; 2 marks for meal, bread, groats, chicory, chocolate, mustard, plum conserve, or tobacco; 1½ mark for spices; 1 mark for coffee, cheese, seltzer water, or fruit juices, and ½ mark for sugar.

WORK IN THE PARIS MUNICIPAL CHEMICAL LABORATORY DURING JULY, 1883.

The Paris authorities having adopted a new mode of reporting their Chemical Laboratory work, we print a full translation of the last Report.

Report of the Inspectors.

Establishments and Markets visited	3876
Samples	572
Destroyed (damaged substances) and illegal	98

Note.—The samples left by the public at the laboratory, or those collected by the Inspectors, are generally suspected to be of bad quality. The samples cannot therefore under these conditions represent the average quality of alimentary provisions sold commercially in Paris.

ANALYSES MADE DURING THE MONTH OF JULY.

Nature of the samples analysed.	Total A	Good B	C	The other samples are classed as follows:
Wines	592	88	46	Illness of wine (acid, bitter, fusty, &c.)
			74	Flavour disagreeable (taste)
			184	Plastered above 2 grammes.
			1	Deplastered
			209	Adulterated by the addition of water.
			31	,, by sugar or sour wine.
			1	,, by foreign colours.
			6	,, by salicylic acid.
Vinegars	3	1	—	Adulterated by dilution.
			1	,, by the substitution of alcohol vinegar to wine vinegar.
			—	,, by the addition of mineral acids.
			1	,, by forbidden colouration.
Beers	20	11	3	Adulterated by dilution.
			2	,, by adding glucose.
			4	,, with salicylic acid.
			—	,, with foreign colouring matters.
Ciders	8	2	6	Adulterated by dilution.
			—	,, by colour.
			—	,, by salicylic acid.
Alcohols and Liqueurs	59	1	18	Using alcohol with a bad taste.
			7	Adulterated with foreign colouring matters.
			7	,, with salicylic acid.
			22	,, (glucose, and various).
Syrups	4	4	—	Adulterated by adding glucose.
			—	,, by forbidden colouration.
			—	,, with salicylic acid.
Waters	19	4	13	Contaminated with mineral matter.
			9	,, with organic matter.
Milks	300	168	132	Adulterated by dilution.
Butters	19	13	6	Rancid.
			—	Adulterated by the addition of water.
			2	,, by the addition of foreign fat.
Bread	2	—	1	Inferior flour used.
			1	Adulterated with copper salts.
			1	,, with alum.
Preserved goods	—	—	—	Tainted.
			—	Coloured with copper.
Chocolates	7	3	2	Adulterated by the addition of flour.
			1	,, ,, ,, foreign seeds.
			2	,, ,, ,, shell.
Flours	21	8	8	Adulterated with foreign flour.
			6	Not suited for bread making.
Peppers	17	8	9	Adulterated with olive stones.
Oils	2	1	1	Adulterated with foreign oils.
Sweetmeats	2	2	—	Coloured with forbidden substances.
Coffees	1	—	1	Adulterated with chicory.
Chicorys	—	—	—	Adulterated with mineral matter.
Meats and Fish	5	2	3	Tainted
Pharmaceutical preparations	3	1	2	Not prepared according to the prescription or Pharmacopœia.
Perfumery	2	1	1	Forbidden substances.
Oil cloths, &c.	13	6	7	Forbidden colouring matters
Toys	2	—	2	Forbidden colouring matters.
Tins	16	8	8	Presence of lead.
Colouring materials	2	1	1	Forbidden colouring matters.
Spices	1	1		
Various	153	18	135	Artificial, &c.
Total	1273	360		

Note.—The totals of the columns B and C will not agree with the number of the analyses made, for the same sample may be counted under several headings in column C.

SAMPLES ENTERED IN JULY.

Nature of the Samples Entered	Public Service.		Inspectors' Samples	Totals
	Qualitative Analyses.	Quantitative Analyses		
Wines	431	24	78	533
Vinegars	3	—	1	4
Beers	5	5	—	10
Ciders	3	2	—	5
Alcohols and Liqueurs	2	1	2	5
Syrups	—	—	—	—
Waters	14	6	6	26
Milks	34	1	300	335
Malts	1	—	—	1
Butters	—	3	6	9
Oils	—	—	—	—
Flours	—	—	15	15
Breads, Cakes	2	—	—	2
Sweetmeats	1	1	1	3
Meats	3	—	—	3
Preserved Goods	—	—	1	1
Salt, Pepper	2	—	9	11
Chicorys, Coffees, Teas	1	—	—	1
Chocolates	2	—	5	7
Honeys	—	—	—	—
Preserves	—	—	—	—
Colouring Materials	1	1	1	3
Toys	—	—	—	—
Coloured Papers	13	—	2	15
Tins	—	—	5	5
Spices	—	—	—	—
Pharmaceutical Products	2	—	—	2
Perfumery	1	1	—	2
Various	6	6	140	152
TOTAL	527	51	572	1,150

WORK DONE BY THE PUBLIC ANALYSTS DURING 1882 UNDER THE SALE OF FOOD AND DRUGS ACT.

IN response to the Circular Notice sent out by the Secretaries of the Society of Public Analysts, a large number of returns of analyses made under the Act during 1882 have been received, but several more have yet to come to hand in order to make the table as complete as we have usually been enabled to do.

We issue with this number a tabulated list of the returns already received, and trust that those analysts whose names are missing from the table will send their returns to the Secretaries by the 15th inst, so that a supplementary list may be issued with our next number, when we can also make an examination of the table and compare it with those of former years.

CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

CHEMICALS IN BEER.

To the Editor of "The Analyst."

Sir,—Although it seems impossible by analysis to obtain proof of use of these when added in moderation, Analysts should bear in mind that their use is common. I would direct attention to the quantity of Magnesia. This latter has been overlooked. The quantity of MgO should not in a pure beer exceed 17-18 grains per gallon. No reliable analyses on the subject exist. Magnesia ordinarily being expressed as in 100 parts of ash, further analyses are necessary to determine a standard.

Magnesia is introduced into beer:—

1. By artificial Burton Water
2. By Sulphite of Magnesia.
3. By C and D solutions: this latter is largely used by brewers; according to patent, it consists of Chloride of Magnesia and Sulphite of Soda. A few analyses of beer for amount of Magnesia would be useful for statistical purposes in your next number.

Yours, &c.,
PURE BEER.

[The writer encloses us a patent specification and an advertisement purporting to be by two Brewers and Analytical Chemists (?) both pointing out the great advantage of doctoring brewing liquor with Salts of Magnesia.—Editors Analyst.]

PUBLIC ANALYSTS' REPORTS.

Dr. C. A. Cameron, Analyst for Dublin, reports that during June last he examined 60 samples of milk, of which 12 were adulterated in some cases with as much as 100 per cent. of water. He also examined 2 samples of coffee, 3 of mustard, 3 of pepper, and 4 of drugs.

Mr. F. W. Stoddart, Public Analyst for Bristol, reports that during the quarter ending June 30th, the total number of samples forwarded him for analysis under the Food and Drugs Acts amounted to 72, eleven of which were handed in by the public, and the remainder by the inspectors appointed under the Act. Seventeen of the samples of various foods dealt with by him, or nearly one-fourth of the whole submitted, have been condemned. Of the twenty-four samples of milk forwarded, nineteen were found to be genuine, and the remainder adulterated with from fourteen to five per cent. of added water. Butter comes next on the list with sixteen samples, and is a high testimony to the purity of this branch of the provision trade—all samples being declared free from adulteration. Coffee does not come out of the ordeal nearly so creditably, as of the thirteen lots dealt with by the analyst, considerably more than half was found mixed with chicory to the extent of 85 per cent., another 80 per cent., two 75 per cent., and so on down to 5 per cent. Lard was tested on seven different occasions, and revealed but one adulterated lot, this sample showing a water addition of 21·8 per cent. Of mustard, three of five samples were found to be mixed with starch and turmeric, in two cases 50 per cent., and in the third case, 12 per cent. The sample of whisky emerged with the claim to be genuine, as did also the confectionery and bread submitted.

Bloater Paste.—In the twenty-seventh annual report of the St. Saviour's District Board of Works, just published, the Analyst to the Board (Dr. Bernays, Professor of Chemistry, St. Thomas's Hospital) says:—"I have taken two potted meats and two extracts of meat. Both the potted ham and the potted bloater paste were of excellent quality. The bloater paste was coloured with a little oxide of iron, as the public will have it so. There is no adulteration, as the fact is stated upon the label, and is confirmed by analysis. It seems that the attempt to sell the bloater paste without the colouring matter has failed, and, as the appearance of the paste without the colour is not so agreeable to the eye, the colour added is the least objectionable. Both of the meat extracts are good. No. 51 is the better of the two. They are excellent stimulants, and best adapted for admixture with weak beef-tea. In households where soups are a common feature of the dinner-table, the introduction of such extracts would be a real economy. They contain no albumen, and this should be supplied, when necessary, by fresh meat."

Tinned Fruits were the subject of a special report to a recent meeting of the Marylebone Vestry by Mr. A. Wynter Blyth, medical officer of health, who stated that he felt it his duty to specially draw the attention of the Vestry to the sale of fruits preserved in tins. He had analysed 21 samples, viz., 11 of preserved apricots, 8 of preserved tomatoes, and 2 of preserved pineapples ; every one of the samples contained in solution a probably injurious quantity of tin; the least quantity found being equal to 1½ grains per lb., the largest to 11 grains per lb., the mean of the whole being about 4½ grains per lb. The explanation of the contamination was, that the acid juices of the fruit acted upon and dissolved the tin. He would suggest that some kind of notice of these facts be given by the Vestry to the sellers of preserved fruits. No action was taken upon the report by the Vestry, it being considered that the publicity given by the Press would be sufficient.

LAW REPORTS.

A Lame Defence:—

In the Northern Police Court, Dublin, before Mr. Keys, Q.C., Eliza O'Brien, of 27, Upper Ormond Quay, milk contractor and purveyor to the Dublin Garrison, was prosecuted at the suit of Mr. David Toler, food inspector, for having supplied a quantity of new milk for the use of the prisoners at the Military Prison, Arbor Hill, the said milk being adulterated with 40 per cent. of added water.—Mr. Adams, B.L. (instructed by Mr. McSheehy, law agent to the Corporation), prosecuted, and Mr. Edward Ennis, solicitor, defended.—Inspector Toler deposed that on Sunday morning, 10th June, from information he received he visited the Military Prison, Arbor Hill. He secreted himself in one of the passages from half-past six till eight o'clock, at which hour the milk was delivered to the Prison by a sub-contractor named Joseph Cassidy. There were 117 prisoners at the time undergoing terms of incarceration of from six months to two years, and the quantity of milk supplied for their consumption on this particular date was less than *four* gallons. Mr. Toler demanded a sample of the milk, and submitted it to analysis by Professor Cameron, who certified that it was adulterated with 40 per cent. of added water. Mr. Toler also stated that the day before he had been served with a notice that the milk the subject matter of this prosecution was supplied by Mrs. O'Brien under a "written warranty" with the sub-contractor Joseph Cassidy, and that she (Eliza O'Brien) relied upon that document for her defence. The inspector, however, informed the Court that a few days subsequent to the 10th June he visited Mrs. O'Brien's establishment at Ormond Quay, and elicted from her the statment that there was *no* "written warranty" between herself and Cassidy. The officer, therefore, called upon Cassidy to produce the document, which on examination was found to be dated "15th June."—The sub-contractor Cassidy—who gave his evidence with great reluctance—said that his man got drunk the night before, and, as he was hardly sober on that morning, "*he made a mistake and left the wrong milk at the prison.*" On cross-examination Cassidy admitted that there were *three* cans of milk in charge of this man. One of the cans was to be left at the Arbor Hill Hospital, and the other at the Royal Infirmary, Phœnix Park.—Mr. Adams: "Perhaps, Sir, on the whole you did the best thing under the circumstances, to deposit the '40 per cent.' can at the prison, and not bring it to the hospital."—To the inspector: Was there a complaint against this contractor before?—Mr. Toler: Yes; on one occasion O'Brien supplied this prison with milk which was adulterated with 143 per cent. of water—and another time served the 1st Battalion Scots Guards, then stationed at Ship Street Barracks, with three consignments of new milk, which were adulterated with from 51 to 69 per cent. of water. For these offences he was fined £37.—Mr. Ennis: Thanks be to goodness it is nothing worse than water. Mr. Ennis then examined Mr. Toler as to whether he had ever taken samples of milk at Cassidy's dairy, 21, Charlotte Street.—Mr. Toler replied that he had done so, and that they were pure, which was, no doubt, chiefly because his appearance was so well known amongst the dairy keepers of Dublin.—Mr. Adams: I press for a heavy penalty in this case. Here were 117 unfortunate prisoners supplied with less than four gallons of milk for their daily allowance. If it was pure it was bad enough, but to think that it was a decoction of nearly half milk and water was perfectly scandalous.—The magistrate said the case was certainly a bad one, and fined the contractor £10.—Cassidy said he was not aware that there were previous complaints concerning his milk.—Mr. Toler: There are *seven* in writing.

Owen Edwards, trading as Kibble & Co., Broadway, Deptford, was summoned by the Greenwich District Board of Works under the Adulteration of Food and Drugs Act.—Mr. Lockyer, for the defence, said Owen Edwards was not the proper person, it should have been Mr. Wells or Mr. Maltby, but if Mr. Spencer liked he could have the summons amended.—Mr. Borsbery, Inspector, said he went to the shop of Kibble & Co. on April 25th, and asked for a pound of butter, and paid 1s. for it, receiving a receipt for the shilling, and he then said he purchased it for analysation, and the person who served him said he would not find any butter in that, as it was butterine, and he had better change it. Witness told him it was his, and he had paid for it. A portion of the butter was sent to the Analyst, who certified that it was butterine, which consisted of fat, which after purification had been churned with milk, but was not injurious to health.—In reply to Mr. Lockyer, the Inspector said he had often dealt at the defendant's shop, but that was the first time he had been there as inspector. Had bought butter before as a private individual, but had never bought it for a shilling.—Mr. Lockyer said he could not dispute the sale of the article, but there was an element of unfairness on the part of the inspector which should guide the magistrate in his decision. The inspector was a regular customer, and when he asked for a pound of shilling butter the salesman was taken off his guard, although it was not right for him to do so. They sold no shilling butter, but butterine, which was preferred by some of the customers to common butter for pastry. It was an instruction from the principal of the firm whenever butterine or shilling butter was called for, the seller should say it was butterine, and the inspector being a regular customer, it was supposed when he asked for shilling butter that he wanted it for pastry. The price list also described the article as butterine, and in it there was no butter for a shilling a lb.—Mr. Balguy said a person of the inspector's experience should have known that he could not get butter for a shilling, but it appeared to him that the shopman ought to have stated to the customer that it was butterine and not butter. Messrs. Kibble should take warning, and put up in the shop notice of butterine.—Mr. Lockyer said that was done.—The inspector said he saw no ticket on any of the butters, but knew butter could not be bought under 1s. 6d. a pound.—Mr. Balguy imposed a fine of 10s. and 2s. costs, the shopman not having stated the article was sold as butterine.

Butter and Butterine.—What is not a Proper Label:—

Mr. John M'Shane, provision dealer, 272, Great Homer Street, was recently summoned at the Liverpool Police Court, under the provisions of the Food and Drugs Act, for having, on the 19th July, sold butter adulterated with 80 per cent. of ingredients other than genuine butter. There were present on the bench Messrs. David Radcliffe (chairman), O. H. Williams, E. Browne, and J. Yates. Mr. Marks, solicitor, prosecuted; Dr. O'Feely, defended. On the day in question a sanitary inspector, named Baker, visited the defendant's shop and asked for 1 lb. of butter at 1s. Having been supplied, he informed the salesman that he was about to have the article analysed. Mr. M'Shane was sent for, and, having been asked about the sale, said, "Oh, it's all right; it's labelled." A portion of the butter was left with Mr. M'Shane, and the remainder was taken to the City Analyst, Dr. Brown, who pronounced it to be adulterated with 80 per cent. of fat derived from beef. According to the statement of Mr. Marks, there was no label on the parcel of butter sold to the inspector. There certainly was a piece of paper in the folds of the paper which covered the butter, upon which was written in pencil "with butterine." If it had been labelled properly, Mr. Marks continued to say, it would have protected the vendor under the 8th Section of the Act, but the inspector failed to find any such notification until he was informed of it by the defendant's shopman; and the slip of paper which had subsequently been discovered, and which no doubt would be relied upon and set up as a defence, was not a sufficient notice, and such a one as was demanded by the Act of Parliament. Evidence was given by Baker and another inspector. The former, in reply to Dr. O'Feely, said he did not taste the butter on the occasion on which he made the purchase from the defendant. The notification in pencil alleged to be written by the defendant he did not see written in the shop. It formed part of a larger sheet of paper, which became fragmentery on account of its contact with water. Roger M'Guinness, the defendant's assistant, was called, and said he wrote the words "with butterine" in the shop, and Baker could have seen him do so had he wished. It was contended by the defence that the written notification referred to, enclosed in the parcel of purchased butter, was in compliance with the provisions of the Act. Dr. O'Feely said the words of the Act were that the vendor "shall give notice by a label distinctly and legibly written." The Chairman held that the label or enclosed notification was not sufficient; that it was at variance with the spirit of the Act of Parliament, inasmuch as it was not placed on the article sold. The defendant was fined 40s. and costs.

John Martin, provision dealer, 72, Brownlow Hill, was also summoned for a similar offence, the article sold as butter in his case being adulterated 82 per cent. He was fined 20s. and costs.

Butter Analysis.—Question as to time of Drying Fatty Acids :—

William H. Wade, grocer, 35, West Street, Gravesend, was summoned at the instance of the Urban Sanitary Authority for selling adulterated butter. Mr. Sharland, town clerk, prosecuted; Mr. Mitchell defending. By the instructions of the Inspector under the Food and Drugs Act a man named Outrid went to the defendant's shop on the 25th of July and bought half-a-pound of butter at 14d. a pound. The inspector then informed Wade that he was the purchaser of the butter, and that he intended to have it analysed, offering to hand to the seller one-third of the half-pound. This was refused, and the whole of the butter was given to Dr. Gramshaw, the Borough Analyst. Subsequently, however, by the advice of his solicitor, Mr. Wade applied for a third portion of the sample that had been taken, and after it had been sealed in the presence of the magistrates he was allowed to remove it for independent analysis. Dr. Gramshaw's certificate was to the effect that the sample was "not of the nature, substance, and quality of butter." His report, however, he said, needed a qualification, viz., that in his analysis he might not have dried the fatty acids quite sufficiently. He had dried them for two hours but if he had dried still more it might have reduced the proportion by two degrees. If it had been so reduced the butter would still have been adulterated. The analysis was—"Fatty acids, 95·53. No change injurious to the sample has taken place. There is little or no butter in this sample." Mr. Gramshaw added that the sample was decidedly adulterated. The fatty acid in genuine butter was 87·3, and in lard or fat it was 95·5. Cross-examined: The presence of 95 per cent. of fatty acids was incompatible with genuine butter. Mr. Mitchell, for his client, said this was a serious matter, both to the retail and the wholesale dealer, Mr. Tom Smith, who had supplied the butter to the defendant. He called Mr. R. H. Harland, F.C.S., F.I.C., of the firm of Wigner & Harland, in business at Lombard Street, E.C., who had made an independent analysis of a sample of the butter, which he had found to be perfectly genuine butter. He received it closely sealed up. Both the specific gravity (913·7) and the insoluble fatty acids (89·09) were such as would be expected to be found in genuine butters of this class. He considered that Dr. Gramshaw had not sufficiently dried his fatty acids. Two hours drying was not enough, the usual time was from twelve to sixteen hours. If the butter was dried only for three or four hours, in the way that Dr. Gramshaw made the analysis, the analyst might get a variation of two or three per cent. Mr. Tom Smith, wholesale grocer, of King Street, Gravesend, deposed that he sold this butter to Mr. Wade. He had no hesitation in saying that this sample was genuine butter. By the Mayor: He believed at this time of the year butter made solely from the milk of the cow could easily be sold by the retailer at fourteen pence a pound. Mr. Sharland then asked the bench to order that the third remaining portion of the sample should be sent up to Somerset House to be officially tested. Mr. Mitchell, however, urged that, in the face of an analysis which was admittedly open to question as to the manner in which it had been conducted, it was unfair to keep the defendant in suspense. The Mayor said it was a case of great importance to shopkeepers and customers, and the bench considered it best, in the conflict of the analyses, that the suggestion of the prosecution should be adopted, and the third portion of the butter be sent to the Commissioners of Inland Revenue for examination. The case was adjourned for a fortnight, in order that this analysis might be received.

At the adjourned hearing on the 17th August, the Town Clerk said he understood that the certificate from Somerset House falsified the report of the Borough Analyst, while it sustained that of Mr. Harland. —The certificate of the Somerset House Laboratory was as under:—"The sample of butter referred to in the annexed letter" (that of the clerk to the justices), "and sealed as described therein, was received here on the 4th inst. We hereby certify that we have analysed the butter, and declare the results of our analysis to be as follows:—Water, 9·02 per cent.; curd, 1·81 per cent.; salt, 2·50 per cent.; fat, 86·67 per cent. From a consideration of the results of a full analysis of the fat we are of opinion that the butter is genuine." The certificate was signed, "J. Bell, Ph.D., R. Bannister, G. Lewin." Mr. Mitchell asked for an order of the bench dismissing the case, and this was granted; whereupon defendant's solicitor asked for full costs against the prosecution, remarking that the charge had been a serious loss to his client, whose takings had fallen off several pounds a week in consequence.—The bench decided to allow the defendant £5 5s. for the analysis he had obtained, and £3 3s. for the solicitor's costs. It was ordered that copies of the analysis should be given to the defendant.

RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

No. 1882.	Name of Patentee.	Title of Patent.	Price.
5671	C. D. Edman	Obtaining Colouring Matters	4d.
5698	L. Heppenstall	Dyeing Aniline Colours	4d.
5713	W. J. Cooper	Distillation of Coal	4d.
5714	W. C. Horne	Manufacture of Luminous Paper	4d.
5742	S. P. Thompson and J. D. Husbands	Electric and Magnetic Apparatus for Telephonic Purposes, &c.	4d.
5765	W. C. Clennell	Treatment of Substances Containing Mixed Animal and Vegetable Matter, to separate the same	4d.
5766	J. Walker	Treatment of Materials used in Purifying Coal Gas for Recovery of useful Products therefrom	4d.
5767	W. A. Barlow	Accumulators or Secondary Batteries	6d.
5769	E. G. Brewer	Electre Magneto and Electro Dynamo Machines	4d.
5783	W. A. Barlow	Magneto and Dynamo Electric Machines	2d.
5785	L. A. Groth	Preparing Fluid Isinglass from Cod Fish Bladders	2d.
5786	Ditto	Preparing Fluid Glue from Fish, &c.	2d.
5787	Ditto	Extracting and Preserving Oil from Fish, &c.	4d.
5788	Ditto	Preparing Extract from Fish, &c., for Food	4d.
5796	W. R. Lake	Electric Lamps	6d.
5809	J. Hargraves & T. Robinson	Treating Hydrochloric Acid	6d.
5833	J. Wavish and J. Warner	Incandescent Electric Lamps	2d.
5861	P. M. Justice	Gaso Electric Lamps	2d.
5887	L. Hartmann	Voltaic Batteries	2d.
5913	F. Wirth	Production of Magnesia Salts from Sulpho Acids	4d.
5914	C. D. Abel	Oxidising Textile Fabrics	4d.
5918	H. H. Lake	Dynamo Electric Machines	8d.
5927	F. C. Glaser	Manufacture of Bichromate of Potash	4d.
5932	P. G. Oster	Preparation or Compound for use as a Substitute for Linseed Oil	4d.
5952	I. A. Timmis	Pressing Asbestos into Wood, &c.	2d.
5961	G. L. Anders & J. B. Henck	Dynamo or Magneto Electric Machines	6d.
5966	J. Jameson	Effecting Condensation of less Condensible Matters Contained in Gas	2d.
5977	J. Rapieff	Galvanic Batteries	4d.
5981	R. Nicholls	Treatment of Town Sewage	4d.
6019	W. S. Horry	Dynamo Electric Machines	6d.
6022	W. A. Barlow	Producing Monalcoholized Hydric Bases	4d.
6058	C. A. Faure	Treatment at High Temperature of Alkaline Salts and Metals	6d.
6075	L. A. Groth	Incandescent Electric Lamps	6d.
6083	D. Milne and L. B. Miller	Electro Motors	6d.

BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Science; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry; Agricultural Chemical Analysis, by Dr. Percy F. Frankland.

THE ANALYST.

OCTOBER, 1883.

THE STORAGE AND DISTRIBUTION OF PETROLEUM.

Some important evidence was given in reference to the storage and distribution of petroleum in London and Liverpool, before the Select Committee of the House of Lords appointed to consider the Petroleum Bill.

From the evidence of Mr. Phillips, of the firm of Messrs. Ingall, Phillips & Co., the principal wharfingers of petroleum and other oils in London, it would appear that the storage capacity of that firm alone in London is equivalent to between 4,000,000 and 5,000,000 gallons. They are at present building new works, the tank space in which is to be 160,000 gallons. The older form of tanks are arranged partly underground, rising to a height of about 4 feet above ground; this portion is protected by a wall and about 3 feet of concrete, and the roof is formed of a layer of chalk about 1 foot thick. In the more modern form of storage tank the covering is arranged so that a current of air can pass over the surface of the stored petroleum. According to the practical experience of this witness, it would seem that a tank open to the air is more suitable for storage than one which is closed; in the latter case, the manholes are protected by a layer of earth. The reason for this, we should imagine, is not far to seek. In the one case, the more volatile portions are sealed up ready to take fire, either by the approach of a light, or from a sudden or undue rise of temperature; while in the case of the open tanks the current of air carries off the volatile vapours as fast as they are generated. As nothing is stored but the usual class of petroleum with a fairly high flashing point, the loss by evaporation is not sufficiently sensible to weigh against the greater safety brought about by this system. In Liverpool, the storage tanks are excavations made in the solid red sandstone rock, one side being built with concrete and brick. The following description taken from the evidence of Mr. Bignell gives a clear idea of the magnitude to which the American petroleum trade has attained in that place. The stores are situated on the east and south side of the Herculaneum Branch Dock—those on the east, 49 in number, being at a distance of 102 feet, and those on the south, 11 in number, a distance of 60 feet from the dock margin. They are all formed by excavation in the solid red sandstone rock, which in this position rises to a height of from 45 to 60 feet above the level of the quay. The stores on the east quay are of the uniform internal dimensions of 51 feet by 20 feet, and those on the south average 37 feet by 20 feet, the height in each case being 19 feet. The rock piers separating the stores are 5 feet in thickness. In the construction of these stores special attention has been paid to the requirements of the fire insurance companies. The sill of the doorway is at a height of about 5 feet above the level of the floor, and the walls are coated with Portland cement to the same height, and no connection whatever has been provided between the different stores, so that in the case of fire or leakage the whole contents of any store would be retained within itself. All doors are of iron.

Mr. Dowling, of the firm of Messrs. Pinchin, Johnson & Co., who are refiners of crude petroleum, stated from his own knowledge that some retailers in the poorer suburbs of London, sell as much as 200 gallons of oil on Saturday evening. The product with which Messrs. Pinchin, Johnson & Co. deal is the crude article. It is of a dark color, and a specific gravity of 800. On being submitted to the usual form of purification, namely fractional distillation, the following are the results :—

Petroleum Spirit	15 per cent.
Kerosine (Petroleum, or Burning Oil) ...	65 ,,
Heavy Lubricating Oil	10 ,,
Carbon Water, and loss by decomposition...	10 ,,

The light petroleum spirit has to a great extent taken the place of solvent naptha, and is a well known commercial article, being used for the production of lighting gas, and as a solvent in connection with the manufacture of waterproofing, and the various forms of floorcloth, linoleum, &c., trades which have only been developed during the last few years.

Mr. Dowling also stated that, on making an inspection of the ruined premises of a burnt warehouse, in which had been stored resin, turpentine, pitch, tar, &c., and also the usual class of burning petroleum, that only 10 per cent. of the latter had been damaged by the fire, the remainder being intact, and was afterwards sold into consumption, although some of the barrels bore fire marks and showed evidence of having been subjected to a fair degree of heat.

It is clearly evident from the above, that the storage of petroleum, providing always that the lighter portions have been abstracted from it, is perfectly safe, if only reasonable precautions are taken, which suggest themselves to any one who has a fair knowledge of the chemical nature of the hydro-carbon with which he is dealing. That this is so, and that the subject is better understood in the United States (the headquarters of the petroleum trade), is evident, or otherwise accidents would be continually occurring, bearing in mind the enormous consumption of this material in the east, and in all countries where the use of gas is precluded, on account of its expense. The question naturally arises—is ordinary burning petroleum of specific gravity 810, and flashing above a temperature of 73° Abel test, more dangerous for storage and public use, than the millions of cubic feet of gas which are contained in gasometers in and around London? We think not. Petroleum of this kind will not ignite and burn (without the intervention of a wick) except at a temperature considerably above that of boiling water. Of course, petroleum vapour when mixed with air is as explosive and quite as easily ignited as ordinary coal gas; but the difference between the two, is this—the vapour of petroleum when the liquid is properly and carefully stored, is produced in small quantity, and is rapidly disseminated into the atmosphere, whereas gas from coal is stored and distributed in such a way as to render it liable to admixture with a few volumes of atmospheric air, in which case it is violently explosive. So long as the whole of the vapour of petroleum is removed from the surface of the liquid in the tanks no danger is likely to arise from the formation of explosive compounds; and, in tanks built partially underground and properly constructed, the temperature of the liquid is such that only a comparatively small quantity of vapour is generated—and again the petroleum risk is confined to the area where this substance is stored, whereas the gas risk is not only present at the works, but throughout the whole district where it is distributed.

On the whole, we think, that providing ordinary care is taken in the inspection of the oils as they are imported into this country, and the present regulations as to storage efficiently and properly carried out, that no further parliamentary legislation is called for. Petroleum is really not so dangerous as turpentine, or many of the vegetable oils, which when spread out in layers absorb oxygen from the atmosphere, generating sufficient heat to cause them to spontaneously ignite.

ON THE WORK DONE BY PUBLIC ANALYSTS DURING 1882 UNDER THE SALE OF FOOD AND DRUGS ACT.

By G. W. Wigner.

From various causes the annual summary of the results of the Public Analysts' Work has been delayed this year, and as some returns are still missing the analysis cannot be as complete as usual. The preparation of these returns is attended with a good deal of labour, and at times it is impossible that some men can find time for it. Thanks are due to those who have done so.

The year which has passed has witnessed great strides in the success of the anti-adulteration work in the United States, and in France; but elsewhere the condition remains almost as before. The state of things in this country will be judged best from the following facts and averages.

One step, the necessity for which was urged last year, has been obtained by the action of the Manchester Magistrates in calling on the referee chemists at Somerset House to attend to endeavour, though unsuccessfully, to support one of their certificates. The provisions for the collection of samples in larger numbers from the more populous districts still remain the great necessity to the proper working of the Act.

The number of returns received of samples analysed and reported upon during the last eight years have been as follows:—

Year.	Districts.	Samples Examined.	Samples Adulterated.	Percentage Adulterated.
1875-6	109	15989	2895	18·10
1877	127	11913	2371	17·70
1878	168	15107	2505	16·58
1879	212	17571	3032	17·25
1880	237	17919	3132	17·17
1881	219	17868	2960	16·56
1882	196	11900	2158	16·50

The diminution in our number of returns is most marked in the Irish ones, but the number of samples reported—nearly 15,000, is quite enough to deduce an average from and show that adulteration is not yet looked upon by all tradesmen in the light of the robbery which it really is.

The percentages of Milk and Groceries purchased are shown in the following table. It is not considered necessary to give the figures for the other varieties of samples.

Samples Purchased—Percentage on Total.

	1879.	1880.	1881.	1882.
Milk	36·1	40·4	38·7	37·0
Groceries	25·0	21·5	24·2	24·3

The most important calculation is that which shows the percentage of adulteration actually found on each class of article. To make this clear I reproduce the figures for the five preceding years.

PERCENTAGES OF ADULTERATION FOUND FROM 1877 TO 1882, CALCULATED ON THE NUMBER OF SAMPLES OF EACH CLASS ANALYSED.

	1877.	1878.	1879.	1880.	1881.	1882.
Milk	26·07	18·38	22·06	22·00	19·95	20·35
Butter	12·48	13·23	13·93	20·08	12·67	15·24
Groceries	13·03	12·89	11·73	10·43	9·70	10·00
Drugs	23·82	35·77	26·66	20·26	19·09	16·74
Wine, Spirits, and Beer	47·00	29·31	28·30	21·31	23·94	21·11
Bread and Flour	6·84	2·97	4·62	6·33	4·23	4·32
Water	21·63	14·98	21·45	17·73	26·17	28·30
Sundries			10·17	6·66	5·00	7-03
Average	17·70	16·58	17·25	17·47	16·55	16·50

The percentage of adulterated Milk is somewhat worse than last year, but the difference is fractional only. The treatment of Milk is exceptionally lenient towards the "trade," since prosecutions are rare for less than ten per cent. of water, and since the Society's limit is a low one, so that probably it is near the truth to say that about 20 per cent. of water is, on the average, added to all the Milk sold.

Butter shows a higher figure, but in nearly every case the report appears to be for the sale of Butterine under the name of Butter instead of admixture.

Groceries are fractionally worse, but the difference is trifling.

Drugs show an improvement of more than 2 per cent., and have fallen to less than half the maximum found in 1878. Still there is room for further care, and it would be well if those pharmaceutical chemists who can test their own drugs satisfactorily did so in a more systematic manner.

Wines, Spirits, and Beer show a fractional improvement which brings them almost to the level of 1880.

The other items of the table hardly call for remark until we come to the last line, and then it is a wretched conclusion to come to. Five years work from 1877 to 1882 has only reduced the average percentage of adulteration by 1·2 per cent., and the last year has only reduced it by ·05 per cent.; these results being all obtained on samples purchased by officers known, and in many cases recognised as officials.

In the Metropolis itself we have reports of the results of 2,364 samples, and the number adulterated is 382 or 16·15 per cent., very nearly 2 per cent. worse than last year.

I have always in these reports made a summary of the "black list," *i.e.*, of Districts which after appointing an analyst ignore the fact and procure no samples, leaving purchasers in the same condition as before. This year the list, as far as we have it, includes three counties and 42 towns all deprived in this way of the benefit of the Act. They do not manage things this way in France or the States, but Public Analysts are powerless in the matter. If the Inspectors will not purchase, nothing can be done but to wait patiently for the needed amendment of the law.

When is this to come?

I am indebted to the Secretaries of the Society, Messrs. Dyer and Hehner, for procuring these returns for the purpose of this summary, and still further to the Analysts who have prepared them.

REPORT OF THE PRINCIPAL OF THE SOMERSET HOUSE LABORATORY.

The samples analysed in the laboratory during the year ended the 31st March last amounted to 24,312, which number is 4,586 above the average of the previous three years, and upwards of 10,000 more than the number submitted for analysis in the year 1873, or ten years ago.

This large increase has been the result of the gradual growth of the work of the department for several years past, and is obviously of a permanent character. Hitherto, the additional work has been solely met by an increase in the staff of temporary assistants, but it has become necessary to classify the work, and to employ, in some of the branches, the first-class analysts as superintendents, for the purpose of controlling and ensuring the accuracy of the analyses. As the higher class analytical work has also grown concurrently, the partial withdrawal of these analysts for superintending purposes has led to considerable embarrassment and hindrance to business, and, in the public interest, it will be necessary to provide some more certain and reliable assistance.

During the year a committee of the tobacco manufacturers of the United Kingdom memorialized the Chancellor of the Exchequer to raise the standards for moisture and inorganic matter in the calculation of the amount of normal tobacco present in tobacco and snuff exported on drawback. On an investigation into the character of the tobacco now imported, it was found that the standard for moisture might safely be raised from 13 to 14 per cent., but that there were no sufficient grounds for increasing the standard for inorganic matter. In the budget arrangements for the year 1883-84, the standand for moisture was consequently raised to 14 per cent., and the change has afforded much satisfaction to the trade.

Twenty-three examiners have received instruction in the department during the year.

Eight students completed the usual course of theoretical instruction at the Royal College of Chemistry and in the class of practical chemistry in this laboratory. At the final examination by Dr. Frankland seven of them obtained first-class certificates, and the other a second-class certificate.

REFERENCES TO SOMERSET HOUSE UNDER THE "SALE OF FOOD AND DRUGS" ACT.

Thirty samples have been referred to us under the above Act. They comprised milk, butter, whisky, gin, rum, beer, bread, coffee, sweet nitre, ketchup, arrowroot, and ground ginger.

Of 17 samples of milk sent, 12 were alleged to have been watered, and five were pronounced to have been deprived of a portion of their cream. In eight of the cases stated to have been watered, we agreed with the conclusions of the analysts, but in four instances we were unable to confirm their certificates. In four of the five cases in which cream was alleged to have been abstracted we found the percentage of fat to range from 2·49 to 2·79. As the lowest of these is practically equal to the minimum limit recommended by the Society of Public Analysts, it would appear that the respective local analysts had failed to extract the whole of the fat.

In neither of two samples of butter could we confirm the allegation of the presence of foreign fat. One of these cases obtained considerable notoriety from the action of the local analyst, who wrote to the press complaining about our report, but he omitted to mention that the sample had also been analysed for the defence by a Public Analyst of considerable standing, whose conclusions agreed with ours. The matter was taken up by the local authorities, and a correspondence with the Local Government Board ensued.

Four samples of spirits were examined, in three of which we agreed with the analyst. In the fourth case it would appear as if the obscuration of strength caused by the presence of sweetening and colouring matter had not been taken into account.

The beer was alleged to have been adulterated with common salt, but the analyst had evidently followed the practice, commented upon in my last Report, of calculating the amount of salt from the chlorine present, without ascertaining whether or not there was sufficient sodium in the beer to form, with the chloride, the quantity of common salt reported.

The sample of bread contained the unusually large proportion of 89 grains of alum per 4 lb. loaf.

The sample of coffee contained nearly half its weight of chicory.

The sample of "sweet nitre" affords an illustration of a difficulty we sometimes find in giving a certificate which is equally just to the prosecutor and to the defendant. According to the London Pharmacopœia of 1851, sweet nitre or sweet spirits of nitre was prepared by distilling together alcohol and nitric acid in certain proportions. Under those circumstances, the action of the acid on the alcohol is not always alike, and the distillate consists of alcohol holding in solution more or less nitrous ether and aldehyde, according as the action of the acid on the alcohol has been greater or less. This process was modified in subsequent Pharmacopœias, and the British Pharmacopœia of 1867 directs certain quantities of nitric acid, sulphuric acid, copper, and alcohol to be distilled together, and the product, when mixed with a certain quantity of alcohol, is called spirit of nitrous ether. This contains a larger and less variable proportion of nitrous ether than "sweet nitre," prepared by the process laid down in 1851. The first named process, however, is still extensively followed, and we therefore reported that the results of the analysis agreed with those of "sweet nitre," prepared according to a formula given in the London Pharmacopœia of 1851.

The ketchup was not only much below the strength of several commercial samples purchased for comparison, but was also in a state of decomposition.

The arrowroot had been much reduced in commercial value by the addition of 40 per cent. of sago flour, and the ground ginger by 20 per cent. of ground rice.

ADULTERATED DRUGS.

We print a full report of some prosecutions of chemists in the Hampstead district of London under the Sale of Food and Drugs Act. Spirits of nitre and tincture of quinine were the articles alleged to be of deficient quality. The preparations of the British Pharmacopœia were expressly asked for, and chemists must be careful in such cases to supply such. In respect to the tincture of quinine, Mr. Heisch, the Public

Analyst for the district, found only a little over 6 grains of quinine in the ounce, while Professor Attfield, by another process, found 7½ grains to the ounce, and considers that about another ½ grain is lost in the analysis. In consequence of this contradictory evidence, the sample is referred to Somerset House. Two of the defendants declined to receive from the inspector portions of the substances purchased. It is quite incomprehensible why it is that so many tradesmen refuse to avail themselves of the protection which the Act thus provides for them. If they are guilty they are no worse off by having the sample, while, if they are innocent, it is often the only chance they have of justifying themselves. We reprint the report from the *Chemist and Druggist.*

Mr. Alfred Bostock Hill, M.D., L.R.C.P. Edin., L.S.A. Lond., B.Sc. Cert. Cantab., has been appointed Public Analyst for the City of Coventry, at 21s. per analysis, and £3 3s. per day and travelling expenses when required to give evidence, *vice* Swete, resigned.

ANALYST'S REPORT.

Mr. Thomas Fairley, analyst for the borough of Leeds, has furnished the following report for the past quarter:—"The following samples have been received:—Milk 20, butter 12, coffee 3, spirits 3, flour 1; total, 39. Fourteen samples of the milk were genuine, three of poor quality, and three were adulterated, containing 12, 14, and 32 per cent. of water respectively. Three samples of butter were genuine; the other nine consisted chiefly of butterine. Two of the samples of coffee were genuine; the other contained 17 per cent. of chicory. The three samples of spirits were one each of whisky, brandy, and gin, and were all reported genuine. The flour was reported genuine, but of poor quality."

ON UNSWEETENED CONDENSED MILK.

From a report received from M. Vignal, of the College de France, Paris, on the Factory of the First Swiss Alpine Milk Company, and printed in the *Sanitary Record*, it would appear that the keeping properties of unsweetened milk depend to a very great extent upon the degree of care and cleanliness with which the various operations connected with the concentration of the milk are conducted. A first essential to success is the restrictions which are placed on the farmers that the milk is to be of more than fair average quality. This decision being based upon a specific gravity of 1032, all milks below that are rejected; not, perhaps, because they are not genuine, or that any suspicion of their quality is entertained, but simply that the proprietors of the establishment are determined to adopt every possible precaution against the employment of poor or watered milk, which they possibly think would be likely to introduce germs and bacteria—either more difficult to destroy, from their being in an advanced stage of development; or that this class of milk is liable and subject to receiving various contaminations from the atmosphere and surroundings, which must of necessity affect to a greater or less extent, especially when in a condensed form. We know that one or more of our large milk companies are adopting the same course, and refusing to accept farmers' milk below a gravity of 10·20. In fact, thanks mainly to the exertions of the Society of Public Analysts, it is becoming quite customary for large milk consumers to insert a clause in their contracts that all milk delivered shall come up to a certain standard. This is certainly as it should be, and only fair to producer and consumer. It is a pity that some of our magistrates do not take a similar view of the case, and impose heavy fines for adulteration of 10 per cent. of water, instead of the customary few shillings and costs. Poor milk is certainly quite as objectionable as other inferior forms of food, and when retailed as a perfectly sound article at a similar price to the genuine one, it is high time that something was done to prevent such a flagrant form of robbery as is being continually committed barefaced before our eyes. Of course the oft and now somewhat worn-out plea that cows have been known to yield milk of an abnormally low quality, has been and will be urged in mitigation of the offence of adulterating milk with small quantities of water, and of course the country has been scoured all round to find such an animal and when found she has proved of more value and service to the purveyors of milk than a whole herd of best milch cows.

To return to the report of M. Vignal, it would appear that after the milk has been received it is never handled or touched, and the whole of the operations are conducted in pans thoroughly scoured with sand and hot water, and afterwards submitted to the action of high pressure steam. There is no addition of any preservative with the exception of an extremely small proportion of borax, amounting to perhaps ·2 of a grain per gallon, in the unconcentrated milk, the keeping properties of the condensed milk being mainly dependent upon three things—

1. The extreme cleanliness observed in its manufacture.
2. The heating of the milk to a very considerable temperature after condensation.
3. The careful packing and soldering in air tight tins.

The degree of concentration to which the milk is subjected at the First Swiss Alpine Milk Company's works is in the proportion of 3 gallons to 1 of condensed milk; its specific gravity being 1106 at 26° C., at which temperature it is enclosed in bottles or tins. The fact that the color is much darker than ordinary milk is due, so say the directors of the establishment, to the smaller or larger quantity of green food given to the cows, which, says M. Vignal "is a rational explanation, as it is well known that in spring and autumn the butter is yellower than at other seasons of the year, owing to the presence of a certain proportion of chlorophyll in the milk." That this is the case no chemist would dispute, but the dark chocolate color of most of the unsweetened condensed milks is much more likely to be due to slight decomposition of either milk sugar or casein caused by the high temperature employed in presumably destroying germs, and which, perhaps, also accounts for the peculiar flavor of most of these milks, described by some as a 'boiled taste.'

On the whole the report is very favorable, and clearly shows that important progress has been made in the daily increasing industry of "milk concentration." We trust before long to hear that an unsweetened condensed milk has been produced equal in flavor and quality to that milked direct from the cow.

The following is an analysis of the milk by Professor Fresenius, together with a comparison of a diluted sample with fair average milk :—

	Per cent
Casein	10·65
Albumen	1·27
Butter	10·87
Milk sugar	14·26
Inorganic substances	2·36
Total of solid substances	39·41
Water	60·59
	100·00

The inorganic substances are as follows—

	In 2·36 parts.	100 parts.
Borax	0·630	26·69
Natron	0·256	10·85
Lime	0·543	23·01
Magnesia	0·057	2·41
Oxide of iron	Traces	Traces
Phosphoric acid	0·669	28·35
Sulphuric acid	0·049	2·08
Chlorine	0·202	8·56
	2·406	101·95
Loss oxygen	0·046	1.95
	2·360	100·00

	A mixture of one part condensed milk and two parts water.	Pure milk contains on average according to Vieth.
Water	86·87	87·25
Butter	3·62	3·50
Caseine	3·35	3·50
Albumen	0·42	0·40
Milk sugar	4·75	4·60
Inorganic substance	0·79	0·75
	100·00	100·00

LAW REPORTS.

PROSECUTION OF CHEMISTS UNDER THE SALE OF FOOD AND DRUGS ACT.

At the Marylebone Police Court on August 15th, before Mr. A de Rutzen, stipendiary magistrate, Mr. Joseph John William Allen, chemist and druggist, of 19, Elizabeth Terrace, St. John's, Hampstead, and Mrs. Jane Allchin, of 1a, Elizabeth Terrace, St. John's, Hampstead, were charged on two summonses under the Sale of Food and Drugs Act—that they did unlawfully sell to the prejudice of George Allen Smith, inspector for the parish of St. John, Hampstead, certain drugs, to wit:—

"1. Three oz. of tincture of quinine, B.P., which did not contain the proper quantity of sulphate of quinine, viz., 8 grains to the oz.

"2. Six oz. of spirits of nitrous ether, B.P., which did not contain 2 per cent. of nitrous ether."

Mr. S. J. Porter, of the firm of Messrs. Glaisyer & Porter, solicitors, Birmingham, acting under the instructions of the secretary of the Chemists' and Druggists' Trade Association of Great Britain, appeared for the defendants, and Mr. Ricketts represented the parish authorities.

Mr. Porter said that in the cases of Allen and Allchin he wished to apply for an adjournment. As the summonses were served only five days previously, sufficient time had not elapsed to allow of an independent analysis being made of the samples of drugs left with one of the defendants by the inspector.

Mr. Ricketts said that a fifth summons had been issued under the same Act against Mr. Pipe, chemist and druggist, King's College Road. He saw some difficulty in allowing one case to proceed and the others to stand over, more particularly as Mr. Pipe was charged like the others, with selling indifferent spirits of nitre.

Mr. Pipe expressed a wish that his case might be taken at once, but subsequently decided to have it adjourned, with the others, till September 12.

Mr. Porter then said in the case of Allen he had to ask that the Stipendiary would be good enough to make an order that sealed samples of the drugs purchased from the defendant be handed to him for independent analysis.

The Stipendiary inquired how it was that the inspector did not leave sealed samples with Mr. Allen at the time the purchase was made.

Mr. Porter said that the inspector had carried out the requirements of the Act by asking Mr. Allen at the time the purchase was effected if he would have sealed samples, but Allen unfortunately said that he did not care about them. Under the circumstances he should feel obliged if the magistrate would make the order. It was important that an independent analysis should be made.

Mr. Ricketts said that he opposed the application entirely. It was admitted by his friend that the inspector had done his duty in offering samples to Mr. Allen, and when the case was heard the defence would have an opportunity of cross-examining the Public Analyst, and if after that they were not satisfied with his analysis there was a provision in the Act by which the sealed samples could be analysed by the Somerset House authorities. He certainly could not agree to the samples leaving the inspector's hands at that stage.

Mr. Porter said he did not wish that the whole of the samples left by the inspector should be given up, but that they should be further divided, still leaving a portion with the inspector, which might subsequently go to Somerset House if necessary.

The Stipendiary said that he really did not feel disposed to make an order at that stage of the proceedings.

Mr. Porter then asked that the sample in the inspector's hands might be at once transmitted to Somerset House.

Mr. Ricketts said he thought his friend was somewhat premature in making that application.

Mr. Porter said his object in doing so was to save a probable further adjournment at the hearing.

Mr. Ricketts said if the other side made an application for a further adjournment at the hearing, and his worship thought it was a reasonable application, he, on the part of the authorities, would raise no objection.

Mr. Porter said that after what Mr. Ricketts had just said he would withdraw his application for the order.

The adjourned hearing of these cases took place at the Marylebone Police Court, on Wednesday, September 12, before Mr. Mansfield, Stipendiary, when Mr. Glaisyer, solicitor to the Chemists' and Druggists' Trade Association of Great Britain, appeared for two of the defendants.

Mr. Ricketts, in opening the case for the authorities, said he was instructed to commence proceedings against certain chemists and druggists residing in the district of St. John, Hampstead, they having sold, in contravention of the provisions of the Sale of Food and Drugs Act, spirit of nitrous ether and tincture of quinine, the same being below the recognised official strength, and therefore to the prejudice of Mr. Smith, the inspector under the Act who purchased the same. As prosecutions under that branch of the Act were somewhat novel in that court, he proposed to read from the preface to the British Pharmacopœia certain clauses, showing that that book was to be taken as a standard for the preparation of drugs. Having done so, he continued to say that his Worship would see that of all the articles that came within the scope of the Act none were of more importance than drugs, as, if supplied by the chemist above the official strength, the prescriber might thereby cause the death of his patient, and, if below the recognised strength, he would probably fail to give relief to the people. The Vestry of Hampstead therefore, believing this to be a very important matter had ventured to bring five cases into court. Although the certificates of the Public Analyst were *prima facie* evidence, yet these being the first cases of the kind which have been tried in that Court, the prosecution deemed it advisable that the analyst should be present to give evidence if necessary. He proposed to take the case of Walter Pipe first. In that case the analyst found the specific gravity of spirits of nitrous ether sold to be 817·7, instead of 815, and that it contained ·69 per cent. of nitrous ether instead of 2 per cent. as ordered in the British Pharmacopœia; therefore the article was very much weaker than it should have been. He purposed putting the analyst into the witness-box to corroborate that statement, and he thought after hearing his evidence his Worship would be of opinion that it was a very proper case for the authorities to bring forward, and that it was clearly a case coming within the scope of the Act, as there could, he thought, be no question as to the preparation sold being a drug within the meaning of the Act.

Mr. George Allen Smith was called, sworn, and examined by Mr. Ricketts. He said he was inspector of nuisances for the parish of St. John, Hampstead. On June 14 last he visited the shop of the defendant, No. 1, King's College Road, and asked for 6 ozs. of spirits of nitrous ether, B.P., with which he was supplied, and for which he paid 2*s*. The defendant was a chemist and druggist, and he, the inspector, was served by the defendant's assistant. After paying for the article, he said he was an inspector under the Sale of Food and Drugs Act, and that he intended to have the spirit analysed by the Public Analyst, and offered to divide the sample into three parts, when the defendant said he did not require a portion of it, and added he was not sure the article was B.P., but that he had no intention to defrauding the public. He took the bottle to the Public Analyst for the district, having previously marked the sample 50 B.P.; and in due course he received the Public Analyst's certificate, which was put in and read. It stated that the spirit in question was not of the nature, substance, and quality of the article demanded by the purchaser, inasmuch as it did not contain the proper quantity, viz. 2 per cent. of nitrous ether, contrary to the statue in that case made and provided. When he took the bottle to the Public Analyst, Mr. Heisch divided the fluid into two parts one of which he returned to him after sealing it with his seal. That bottle he now produced in the same condition as he received it from the analyst.

Cross-examined by Mr. Glaisyer, he said he left the bottle in which he received the nitre from the defendant with the Public Analyst. He had not seen it since then. He did not know whether it was in Court. He did not know what was on the label when the bottle was handed to him by the defendant. He believed there was a label on the bottle.

As far as he remembered, it was simply a label giving the defendant's name and address. He was not sure it did not bear the name of the article sold, but he thought not. He removed the label, because under the Act the Analyst is not allowed to know the name or address of the person from whom the preparation he is to analyse was obtained. He did not keep the label. He would not swear that the words "Sweet Spirits of Nitre" were not on the label—they might have been, but he did not recollect them. He did not ask for the nitre by word of mouth, but handed over the counter a written order, which he left with the defendant. In addition to the spirit of nitre the order contained the following articles: 2 ozs. of citrate of iron and quinine, and 8 ozs. of tincture of quinine, B.P. Nothing else; no morphia. He submitted all three articles that were supplied to him to the Public Analyst. No summons had been issued on the citrate or tincture. When in the defendant's shop he heard a conversation that took place between the defendant and his assistant, the substance of which, as far as he could gather, relating to the emptying or filling of a shop bottle with nitre by the assistant. The assistant said he had recently filled the bottle; he also gathered from the conversation that there were two articles in use of trade sold as spirit of nitre, one the British Pharmacopœia preparation, and the other made according to the direction of the old, or London, Pharmacopœia. He did not hear whether the assistant had been with the defendant very long. The question was raised as to whether the assistant, when filling the shop bottle, had used the London or British Pharmacopœia nitre; but that was after the purchase had been completed. He had actually paid for the nitre before that part of the conversation had occurred. He had told the defendant he wanted the article for analysis before anything was said about filling the shop bottle. He would swear to that. The defendant told him that the bottle from which he had supplied him was usually filled with the British Pharmacopœia preparation. After the purchase was completed, the defendant told him he did not guarantee the article was British Pharmacopœia nitre. He would not swear that it was not labelled "Sweet Spirits of Nitre." The defendant told him he kept two preparations of nitre in stock. When the defendant said he would not guarantee the article, he replied that he had no alternative but to take it to the Public Analyst.

Mr. Charles Heisch was called, sworn, and examined by Mr. Ricketts. He said he was Consulting Chemist, Fellow of the Chemical Society and Institute of Chemistry, and Public Analyst for the district of St. John, Hampstead. His laboratory was situated at 79, Mark Lane. On June 15 last he received from Inspector Smith a bottle sealed with his seal containing spirits of nitre. He divided the same into two parts, one of which he returned to the Inspector, the other portion he analysed with the result stated by the last witness. The specific gravity he found to be 847·7 instead of 845, and using the tests ordered in the British Pharmacopœia, it gave no appreciable nitrous ether; but by Dr. Dupre's method, which he considered a better method, it contained ·69 per cent. instead of 2 per cent. as ordered in the British Pharmacopœia. He gave the defendant the benefit of that last test. He produced the British Pharmacopœia.

Mr. Glaisyer asked for the date of Pharmacopœia in the hands of the witness. The witness said it was 1864, when Mr. Glaisyer remarked that there was a more recent edition of the Pharmacopœia which differed from the book in the hands of the witness in the tests there mentioned in the article before his Worship. He then produced the 1867 edition, handed same to witness, asking him to read the tests from both editions. Mr. Heisch having done so, continued to say the specific gravity was the same in both editions, and both editions gave a test with chloride of calcium, with this difference in the result:—The 1874 edition stated that, if the spirit be agitated with twice its volume of saturated solution of chloride of calcium in a closed tube, 2 per cent. of its original volume will separate in the form of "nitrous ether," and also to the surface of the mixture; the 1877 edition used the words "etherial liquid" in the place of "nitrous ether." On analysing the sample of spirits before his Worship by the Pharmacopœia test no fluid, either ether or etherial, rose to the surface.

Cross-examined by Mr. Glaisyer, he said he had given considerable attention to the analysis of drugs, having been for twenty-six years connected with the Middlesex Hospital. He was well acquainted with the London Pharmacopœia. Sweet spirits of nitre was mentioned in that Pharmacopœia. He should not say that the drug mentioned in the London Pharmacopœia was made by a totally different method to that ordered in the British Pharmacopœia. He could not recollect what the London form was. The London preparation was in general use, and would probably be supplied by chemists if the British Pharmacopœia was not especially asked for. He believed there was no difference in price between the two preparations in purchasing them in wholesale quantities from the manufacturers. There would be no pecuniary advantage whatever to a chemist in substituting the one for the other. He did not know what was the specific gravity of the London Pharmacopœia preparation. The specific gravity of the article sold by the defendant was too high, which would indicate the absence of so much ether. It was true that the new edition of the British Pharmacopœia stated, in reference to the chloride of calcium test, that 2 per cent. of etherial fluid should rise to the surface, whereas the 1871 edition stated that the proper quantity was 2 per cent. of nitrous ether, but as no fluid of any kind rose to the surface in testing the sample by that process, he considered the discrepancy immaterial.

Mr. Glaisyer said that on the part of his client he admitted that the spirit of nitre supplied to the inspector was made according to the London Pharmacopœia formula, and not according to the British. His Worship would probably have gathered from the cross-examination of Mr. Heisch that there were two preparations known in the trade as sweet spirits of nitre. Both of these were kept in stock by the defendant. Just before the inspector visited the defendant's shop a new assistant had come to him, and it appeared that this assistant had inadvertently filled the shop bottle which usually contained the B.P. preparation with the P.L. article, and that therefore the defendant had supplied the inspector with the old P.L. drug instead of with the P.B. He should put the defendant into the box, and he would tell his Worship that he explained to the inspector before the purchase was completed, that he did not guarantee the article sold to be British Pharmacopœia nitre; furthermore, the defendant labelled the bottle sweet spirits of nitre, by which title the old preparation was best known, and not spirits of nitrous ether, which is the name mentioned in the British Pharmacopœia, so that his Worship would see that he really did all he could, under the circumstances, to put the purchaser on his guard, and where the prejudice to the purchaser came in he could not see. The inspector was supplied with a good sample of the London Pharmacopœia preparation. He would put the defendant into the box to corroborate the statement he had just made, and that would be the only witness he deemed it necessary to call. It should be borne in mind that the other drugs which had been purchased from the defendant had not been found deficient in strength or quality, and that the price of the two preparations of nitre he had referred to were the same, so that the defendant could have had no object whatever in substituting the one for the other, as he had both preparations in stock.

Mr. Walter Pipe was called, sworn, and examined by Mr. Glaisyer: He said he was a registered chemist and druggist, carrying on business at No. 1, King's College Road, where he had conducted the business on his own account for more than twelve years. He had never before been charged with selling adulterated drugs. When he was wrapping up the spirit of nitre for the inspector he turned to his new assistant and asked him if, when he filled the shop bottle a few days previously, he had used the P.B. nitre. His assistant, replying, said he was not sure, as he did not know any distinction was made. He (the defendant, told the inspector that he would not guarantee the article he was selling to be the P.B. nitre, as he kept both preparations in stock, adding that one was quite as good as the other. At the time this conversation took place the inspector had not paid for the nitre, the purchase was not completed. The inspector had however, prior to the conversation, told me that he wanted it for the purpose of analysis.

Cross-examined by Mr. Ricketts: Witness said the inspector brought to him a written order containing, among other articles, spirits of nitrous ether, B.P. The order distinctly stated B.P.; but, by an accident, the inspector was supplied with the P.L., but at the same time cautioned that it might not have been P.B.

Mr. Mansfield said he did not think it was a case which would fairly come within the scope of the Act. The proceedings, however, would certainly be a caution to the defendant to be more careful for the future. It was an accident, no doubt, that the one preparation had been substituted for the other, and taking into consideration the conversation that had occurred at the time of purchase, he felt justified in dismissing the summons.

Mrs. Jane Allchin, 1A, Elizabeth Terrace, N.W., was then charged with having sold, to the prejudice of the purchaser, 3 oz. of tincture of quinine which did not contain the proper quantity of sulphate of quinine.

Police-constable D 38, having proved the service of the summons, Mr. Ricketts said that in this case tincture of quinine had been sold which was very much below the regulation strength.

Inspector Smith called, sworn, and examined by Mr. Ricketts, said: that on June 14 last he visited the shop of the defendant and handed over the counter a written order, which contained among other things, 3 ozs. of tincture of quinine, B.P., which was supplied to him at a charge of 3*s*. He divided the sample in the usual manner, handing a portion to the assistant who served him, and taking another portion to the Public Analyst.

Mr. Charles Heisch called, sworn, and examined by Mr. Ricketts, said: he analysed the sample of tincture of quinine purchased by the inspector in this case; it was marked 44 P.B. Tincture of quinine, made according to the British Pharmacopœia formula, should contain eight grains of sulphate of quinine per ounce; the sample in question contained only 6·2 grains per ounce; that would make a material difference in prescribing the preparation.

Cross-examined by Mr. Glaisyer, he said the British Pharmacopœia ordered the preparation to be made by adding 160 grains of quinine to one pint of tincture of orange-peel, but it does not state what quantity of quinine should be found in the tincture on analysis. He had made tincture of quinine himself and analysed it subsequently, and found it to contain eight grains to the ounce. There might be a slight loss in the analysis, perhaps a hundredth of a grain. He did not keep any of the samples he made for any length of time before he proceeded to analyse them; but some of the preparations he had analysed had been made twelve months. The samples he made himself he had analysed within a few weeks. Even if the tincture was made in cold weather he did not think any of the quinine would crystalise out. He would not swear to that, but as he had kept samples for several months in all sorts of weather he did not think the quinine would crystalise out. He had analysed dozens of samples of tincture of quinine. He employed the following process:—evaporate the tincture to dryness, treat the residue with dilute sulphuric acid, add the smallest possible excess of ammonia, collect the precipitate of quinia, wash it with water, dry and then weigh. That was the only test he employed in the present case to estimate the quantity of quinine. He analysed six samples at the same time, three of which were good samples, and the remainder deficient in quinine.

Mr. Glaisyer said that in this case a sealed sample of the tincture of quinine sold had been left with the defendant, and had been subsequently analysed by Professor Attfield, than whom he supposed no person in the United Kingdom was better acquainted with drugs, including their preparations and analysis. In proof of that assertion he might mention that the Professor had been selected as one of the three appointed editors of the new British Pharmacopœia in course of preparation. The sample of quinine in question the Professor found on analysis to contain 7½ grains of sulphate of quinine. This he would give in evidence, and would also state that the half-grain per ounce remaining to make up the 8 grains ordered in the Pharmacopœia is lost in the process of analysis. He (the Professor) would explain the tests he employed, and that in his opinion the tincture in question was made according to the British Pharmacopœia, and was properly sold as tincture of quinine. With regard to the preparation of the tincture, he should call Mrs. Allchin's assistant who would state that he manufactured the preparation sold, and that he employed the full quantity of quinine ordered in the British Pharmacopœia in his preparation, and that it was sold to the inspector in the same condition. He thought if he could clearly establish these facts, his Worship would see his way to dismiss the summons.

Mr. Edward Charles James Davies was called, sworn, and examined by Mr. Glaisyer: He said that he was an assistant to Mrs. Allchin, and had been in her employ, and that of her late husband, for more than five years. He was a registered chemist and druggist. During Mr. Allchin's lifetime he manufactured pharmaceutical preparations under his direction, and since his death he had done the like work. He made the tincture of quinine, sold to the inspector, by adding 320 grains of sulphate of quinine to 2 pints of tincture of orange peel, that was at the rate of 8 grains per ounce, as ordered in the British Pharmacopœia. The quinine employed was manufactured by Howard. He served the inspector personally with the tincture, he did not not remember exactly when he manufactured the tincture, but it would be about a month prior to the visit of the inspector.

Cross-examined by Mr. Ricketts: He did not make a record in any book at the time he made the tincture with which the inspector was supplied, but he was quite sure he did not make a mistake in weighing the quinine, as he had on so many occasions weighed out the 320 grains for the quart of tincture. He could not account for the Public Analyst finding only about 6 grains of quinine in each ounce of tincture, as he was quite sure the full quantity, namely 8 grains, was put into it.

Professor Attfield was called—sworn, and examined by Mr. Glaisyer—said that he was Professor of Practical Chemistry to the Pharmaceutical Society of Great Britian, and the author of a "Manual on Chemistry," which had run through a great many editions, a Fellow of the Royal Society and of the Institute of Chemistry. He received a sample of quinine from Mr. Allchin's assistant; the bottle was marked 44 P.B., and the cork bore the official seal. He analysed its contents and found practically 7½ grains of sulphate of quinine in the fluid ounce. He extracted quinia equivalent to 7·44 grains of sulphate of quinine to the ounce. From experiments he had made he had come to the conclusion that if 8 grains of sulphate of quinine were used in the preparation of 1 oz. of tincture of quinine, that ½ grain per ounce would be lost in the analysis of the same. He based that conclusion on the analysis of samples made by himself. He heard the Public Analyst give his evidence. The process Mr. Heisch used was a process which he himself had employed several years ago, and he was sorry to say he could place no trust in it; the figures obtained by it might be right or they might be wrong, it was quite possible to get either. It was not the process he adopted in testing the samples sent to him. The process he adopted he considered better than Mr. Heisch's process; he had come to that conclusion after carefully testing both personally. Mr. Heisch's process did not give trustworthy results. The process he used on this occasion did give fairly correct results. It was perfectly well known that tincture of quinine made according to the British Pharmacopœia was liable to lose some of its sulphate of quinine by deposition—it did so quite commonly in cold weather. The sample in this case, he concluded, had not lost any of its quinine by deposition; he was strengthened in this opinion having analysed a portion of the tincture from the bulk from which the inspector was supplied. That contained a deposit, but the deposit was sulphate of lime, and not quinine. He was prepared to say that the article sold was a good sample of tincture of quinine, made according to the British Pharmacopœia.

Cross-examined by Mr. Ricketts: He said the bottle he produced was that from which he took the tincture he had analysed. The bottle, when it came into his possession, was sealed with the official seal of St. John, Hampstead. The cork had not been drawn since it was sealed. The process he employed to analyse the sample was as follows:—Evaporate the tincture to dryness; digest the residue in dilute sulphuric acid; add ammonia, and shake the mixture with chloroform; separate the chloroform; wash the fluid very effectually two or three times with additional chloroform—chloroform had the effect of dissolving the quinia from the watery liquid. Evaporate the chloroform solutions to dryness, treat the residue again with dilute sulphuric acid, and add ammonia and ether—the ether had the effect of disolving out the quinia from the aqueous fluid; wash the fluid very effectually two or three times with ether; finally, evaporate the ethereal solutions to dryness, and weigh the residue. He though that was not only a more elaborate but a more accurate process than that employed by Mr. Heisch. He considered Mr. Heisch's process inaccurate and untrustworthy. He did not know what process was made use of at Somerset House.

Mr. Ricketts said that as there appeared to be considerable difference between the results of the analyses of the two gentlemen who had examined the samples, he should ask that the third sample be sent to Somerset House, and that the case be adjourned for that purpose.

Mr. Mansfield said he really could not undertake to decide between the two analysts whose evidence he had heard, and that the third sample had better be sent to Somerset House and the case adjourned for fourteen days.

Mrs. Jane Allchin was then charged with having sold spirits of nitre, P.B., which did not contain the proper quantity of nitrous ether, viz., 2 per cent.

Mr. Glaisyer said that he had conducted the defence in the previous cases on the instructions of the Chemists' and Druggists' Trade Association of Great Britain. He was not, however, instructed to take any part in the present case. In Mrs. Allchin's absence he would state that in this case also the London Pharmacopœia preparation had been sold instead of the British Pharmacopœia article. It was purchased from a most respectable wholesale house, and sold in the same condition in which it was purchased, and that the wholesale house referred to charged the same price for the one as for the other.

Mr. Mansfield said: I shall impose a merely nominal penalty of 5s. and 2s. costs.

Mr. Ricketts applied for extra costs, which was refused.

Mr. J. J. W. Allen, of 19, Elizabeth Terrace, N.W., was then charged with having sold to Inspector Smith tincture of quinine and spirit of nitrous ether not of the nature, substance, and quality of the article demanded by the purchaser.

Mr. Glaisyer said the defendant was foolish enough to refuse sealed samples from the inspector at the time the purchase was made. He was instructed by the society he represented, and with the sanction of the defendant, to renew the application made at the last hearing, that sealed samples should be handed to the inspector.

Mr. Ricketts opposed the application.

Mr. Mansfield said that as the inspector had offered to divide the samples at the time of purchase, and this offer had not been accepted by the defendant, he did not feel disposed to make an order.

Mr. Glaisyer said that under those circumstances he was instructed to retire from the case.

Evidence having been given as to the purchase of the article and the analysis of the samples, the defendant said that the spirit of nitre sold was P.L. nitre, and not P.B. nitre, which he purchased from a most respectable wholesale house, and that the tincture of quinine he manufactured himself strictly according to the British Pharmacopœia.

A fine of 5*s*. and 20*s*. costs was inflicted on the tincture of quinine summons, and 5*s*. and 2*s*. costs on the other.

Mr. Mansfield said it appeared that the British Pharmacopœia preparation of sweet spirits of nitre had not come into very general use.

Mr. Glaisyer said that when chemists supplied the British Pharmacopœia preparation summonses were not issued, and, therefore, such cases did not come before his Worship.

Milk Adulteration:—

At Woolwich Police Court, Mr. Ephraim Butters, of Jackson Street, Woolwich Common, was charged with adulterating his milk to the extent of 18 per cent. of added water.—James Pitman, called for the prosecution, said he knew that there was water in the milk, for his master put a churn with water in it into the cart when he sent witness to milk the cows. The milk was then passed into the churn with the water.—Mr. Hughes: How much water?—About eight quarts to sixty quarts of milk.—Was this the usual system?—Yes; every afternoon about six quarts of water was put to a churn, which would hold sixty-four quarts, but was seldom full.—Did you ever mix it yourself?—Yes, by defendant's orders.—Mr. Lewis: You knew that you were robbing the public?—Yes, under orders.—Defendant was then called by Mr. Lewis, and said: I dismissed the last witness because I suspected him, for I never put water into the milk to the extent mentioned. I admit putting in a little, like any one else, but my man must have put in more and made money of it (Laughter.)—Mr. Hughes: How much water did you generally put into a churn? About five or six quarts.—Mr. Hughes: That is under 10 per cent., for which you know the Board does not prosecute. And now you think that your servant has followed your example?—I do.—Mr. Hughes: That is possible; but the responsibility rests with you. Mr. Hughes pressed for a severe penalty, and pointed out the large profits which milksellers could make by such offences.—Mr. Marsham said heavy penalties were generally reserved for repeated convictions, but he could not treat this as an ordinary first case, and fined defendant £3 and costs.

Lime-Water and the Sale of Food and Drugs Act:—

In the Summons Court at the Nottingham Town Hall, on August 10th, before Mr. Blain and Mr. Dobson, Mr. James Goodall, chemist of Sneinton Road, was summoned for having sold lime-water not of the nature and quality of the article asked for. Mr. Farmer (from the Town Clerk's office) appeared to prosecute, and Mr. Cann defended. Mr. Farmer stated that the prosecution was instituted by the Health Committee of the Corporation, and the defendant was summoned for selling what was called lime-water, but which they contended was not so according to the provisions of the Sale of Foods and Drugs Act, 1875. The Inspector of Nuisances, Mr. Richards, purchased some of the so-called lime-water from the defendant, and took it to the Borough Analyst, who certified that it was not lime-water in the ordinary acceptation of the term, as it was deficient in the usual quantity of lime to the extent of 47 per cent. Lime-water proper was water holding in solution the largest quantity of lime that it was capable of containing. The Bench would see that that was a serious case as at the present time lime-water was being very freely prescribed by doctors for infants. It was very essential that the attention of chemists should be called to the provisions of the Act. Mr. Cann pleaded guilty on behalf of his client, and, no evidence being offered, the defendant was fined £5.

Mr. Frank White, chemist, of London Road, pleaded guilty to a similar charge, and was also fined £5.

A Standard for Porter:—

At the last County Antrim Assizes, Mr. James Dempsey, brewer, of Belfast, brought an action for libel against Dr. Charles A. Cameron, of Dublin, Public Analyst for the County of Down. The action arose out of a certificate and reports issued by Dr. Cameron. In June, 1881, Dr. Cameron received from a constable, Dunne, Food Inspector at Holywood, County of Down, a sample of porter for analysis. The article had been purchased from a publican named Anderson. Dr. Cameron certified that it contained 3·85 per cent. of solids, and 5 per cent. of alcohol by volume, or 4 per cent. by weight. He further stated that it was a debased article, being poorer than the average quality of Irish porter. The publican was fined £5 by the Court of Petty Sessions. Mr. Dempsey, the brewer of the porter, appeared at the sessions, and at his suggestion the vendor appealed to the Quarter Sessions at Downpatrick, Dr. Cameron was summoned to give evidence in person. He stated that according to his large experience Irish porter should contain from 5 to 9 per cent. of solids, and from 5 to 8 per cent. of alcohol by volume. He believed that the porter in question was largely prepared from saccharine matter. The decision of the Lower Court was affirmed. Subsequently Dr. Cameron reported to the Grand Jury of the County the facts of the case, and in a further report incidentally referred to it as a "debased article." The action was against the Analyst by the brewer of the porter. For the plaintiff, practical brewers were examined to prove that porter often contained less solid matter than 4 per cent. Dr. C. R. C. Tichborne, Professor of Chemistry, and President of the Pharmaceutical Society of Ireland, was examined for the defence, and proved that according to his experience the solids in porter did not fall below 5 per cent. when the alcohol was less than 5 per cent. The jury almost immediately found for the defendant on all the issues—namely (1) whether or not the article was debased, (2) whether or not the defendant acted *bona fide* in reporting to the Grand Jury, and (3) whether or not the plaintiff was injured by the defendant's reports.

In the Southern Division of the Dublin Police Court last month, Mr. William Woodlock presiding, Patrick Byrne, 38, Barrack Street, baker and milk contractor to the garrison was summoned at the suit of Mr. David Toler, food inspector, for having, on July 25th, supplied a quantity of new milk for the use of the 1st Battalion East Kent Regiment, stationed at the Ship Street Barracks, which was adulterated with 213 per cent. of added water. Mr. Richard Adams prosecuted, and Mr. Philip Keogh defended. The adulteration represents nearly two and a half gallons of water to one gallon of milk. Inspector Toler deposed that on July 25 last he attended at the Ship Street Barracks, and saw Owen Donegan, one of the defendant's men, delivering milk at the cook-house, and took a sample, stating that it was for analysis. Witness offered to divide it with the man, as provided by the statute, but the offer was declined. The milk was analysed by Dr. Cameron, who certified the adulteration mentioned. On the 27th the defendant asked witness could he stop the prosecution against him from the Ship Street Barracks. Toler replied, No; that he had his duty to do. Cross-examined by Mr. Keogh: After he took the sample he suggested to the colonel of the regiment that he knew a very good man to supply milk. That was not part of his business as a corporation official. He named a Mr. Costigan, to whom he had never spoken up to that. Subsequently he advised Costigan to apply for the contract. He wrote to the quartermaster of the Devon Regiment at the Royal Barracks to ask did the defendant supply pure milk there. The answer was in the affirmative. The quartermaster at Ship Street stated they were perfectly contented with the milk supplied, and that it had stood their tests. He recommended Costigan to the colonel of the East Kent Regiment, because he kept very good milk. Witness was now aware that the day he took the sample the place was almost deserted, owing to the sports going on at the Richmond Barracks where the men were. When he acquainted the colonel of the adulteration, he suggested that it would look very bad if, in the event of a prosecution, it turned out that the same contractor was still supplying his regiment. In reply to Mr. Adams, the witness said he had no corrupt or interested motives in mentioning Mr. Costigan's name. In reply to the bench, witness said he knew nothing of this 213 per cent. of added water to the defendant's milk until after the analysis was made. There was no plot against Mr, Byrne that he knew of. Mr. Keogh: It is intolerable that this public officer should be a prosecutor of one milk vendor and a canvasser for another. Mr. Woodlock said that might be all very well for another place, and perhaps would be very serious. Lieutenant-Quartermaster Coombs, 1st Battalion East Kent (Buffs) Regiment, deposed that Byrne was engaged when the corps was at Birr, under orders for Dublin, to supply vegetables and milk to the men, receiving a penny per day per man in the mess. The regimental cook-sergeant tested the milk, and had never reported it bad. As a matter of routine no officer of superior rank was present, but if any complaints were made another investigation would be held. Toler said Byrne's milk was very bad, and strongly urged him to get supplies from Costigan. It aroused their suspicious to find a public inspector condemning one milk and recommending another, and the colonel asked witness to tell his worship. Mr. Adams: I object to this. The colonel should come himself if he has anything to say. Further evidence having been given, a fine of £20 was imposed. Mr. Keogh said he would appeal.

RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

1882. No.	Name of Patentee.	Title of Patent.	Price.
4732	H. J. Haddan	Manufacture of Luminous Paints or Colours	4d.
6034	L. P. Thompson and C. C. Starling	Photometric Apparatus	2d.
6229	H. C. L. Dyer	Treatment of Ingots of Steel and other Malleable Metals for the Removal of Impurities	2d.
6240	L. M. Casella	Apparatus for Indicating and Recording the Pressure of the Wind	1s.
1883.			
28	T. Rowan	Apparatus for Denoting and Indicating any Increase in the Temperature of Coal Cargoes	6d.
79	C. D. Abel	Production of Coloring Matters suitable for Dyeing and Printing..	4d.

1883 No.	Name of Patentee.	Title of Patent.	Price.
82	W. Johnstone	Solvent or Emulsion for use with Paints, Pigments, &c.	2d.
87	J. Caley	Apparatus for Indicating and Registering the Presence of Explosive or Injurious Gases in Coal Mines	6d.
96	W. Weldon	Manufacture of Sulphuric Acid	4d.
98	„	Manufacture of Chlorates	2d.
99	„	Recovery of Sulphur from Alkali Waste	2d.
100	„	Recovery of Sulphur from Alkali Waste	2d.
155	J. Brocklehurst	Calcining Limestone	6d.
139	F. Wirth	Production of Aniline	2d.
152	W. P. Thompson	Manufacture of Hydraulic and other Cements, Mortar, Artificial Stone, &c.	4d.
153	W. P. Thompson	Separating Volatile from Non-Volatile Substances	6d.
157	F. Wirth	Recovering Ammonia from Gases of Various Kinds	2d.
159	A. H. Dunnachie	Making Silica Bricks	4d.
241	S. H. Emmens	Reduction of Metallic Ores	4d.
246	C. M. Pielsticken	Preservation of Alimentary Substances	6d.
257	P. Casamajor	Filtering Saccharine and other Solutions	4d.
2341	H. H. Lake	Vulcanizing and otherwise treating Compounds of Caoutchouc, &c.	6d.
2351	G. Downie	Removal and Prevention of Scale in Boilers	2d.
218	F. Wirth	Red Colouring Matters	2d.
227	H. W. L. O. Von Roden	Preserving Milk	2d.
240	R. Stone	Manufacture of Artificial Stone	2d.
242	M. Zingler	Combination and Treatment of certain Materials for the Production of Substitutes for Gutta-percha and Indiarubber	4d.
245	J. H. Barry	Combined Anti-Fouling and Preserving Composition, applicable to Ships' Bottoms	4d.
284	A. Fryer and J. B. Alliott	Manufacture of Sugar, and Machinery or Apparatus therefor	1/1.
292	W. A. Rowell	Manufacture of Salts of Strontia and Oxide of Strontium	4d.
293	W. A. Rowell	Manufacture of Salts of Strontia and Oxide of Strontium	4d.
302	H. E. Newton	Brewing	2d.
275	A. Muirhead	Applying Alternating Electric Currents to the Production of Light	2d.
204	J. Mackenzie	Furnaces for the Treatment of Materials for the Production of Sulphates of Soda and Potash	2d.
332	J. Young	Treatment of Sewage	6d.
337	H. J. Haddan	Process for the Manufacture of Glauber's Salt free from Iron	4d.
362	Baron G. de Overbeck	Process and Apparatus for the Production of Metallic Aluminium and Aluminium Alloys	6d.
367	H. J. Haddan	Removing Vegetable Impurities from Wool	2d.
434	J. Young	Treating Sewage Water	6d.
438	S. G. Thomas & T. Twyman	Manufacture of Phosphates	4d.
540	N. M. Henderson	Distilling or Refining Mineral Oils	8d.

BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Science; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry; Tobacco; Agricultural Chemical Analysis, by Dr. F. Percy Frankland.

THE ANALYST.

NOVEMBER, 1883.

WE have devoted the whole of this Number of THE ANALYST, which is of extra size, to the Report of the Manchester Milk Case, because several important points are raised in it.

The Sanitary Committee of the Manchester Corporation have courteously placed their shorthand notes at our disposal, and we are sure our Subscribers will value a verbatim report of this character. As a full discussion is to take place at the next Meeting of the Society, it is better that we, as Editors, simply point out that the decision clearly upsets the idea which has been held by some Analysts that an Appeal to the Somerset House Chemists was final, and that the case was dismissed because the Defendant was, by law and right, entitled to the benefit of the doubt. It is impossible to dispute this right, and he is perfectly justified in claiming it. Dr. Bell and his coadjutors have, by a vague, open report, which says nothing, simply helped him to his legal rights.

On the same principle, which is, in plain English, that they cannot say whether the milk has been adulterated or not, Dr. Bell and his colleagues may quite possibly prove "doubt" as to every certificate of Adulterated Milk, and an Act of Parliament be rendered quite abortive because, *inter alia*, excise officers were ordered to collect samples of Milk for Dr. Bell, and did not know how to do it. It is happy for the milkmen, but what about the public. We think that the papers at the next Meeting of the Society of Public Analysts—which will, we are informed, include the analysis of Milk from several thousand cows—will so expose the deception which has been played on the Somerset House Chemists, that we shall hear the last of this nonsense.

It is, of course, notorious that it is to the interest of cowkeepers to have done all in their power to bamboozle the so-called officials who took the Somerset House Milks, and they succeeded very well.

Two hundred Milks bought in London do not differ as much as Dr. Bell's "Dairies". Comment is useless.

LAW REPORT.

Manchester.—Appeal against a Conviction for selling milk adulterated with 4 per cent. water.—Reversal of Judgment.

SPECIAL REPORT TAKEN BY REQUEST OF THE CORPORATION OF MANCHESTER AND THE PROPRIETORS OF *THE ANALYST*.

At the Sessions Court, Minshull Street, Manchester, on the 6th of October, 1883, before H. Wyndham West, Esq., Recorder, the case of Wardle *v.* Edwards was heard. We reprint the following verbatim report from the shorthand notes of Messrs. Snell & Son, 86, Chancery Lane, London, W.C., and 64, Fountain Street, Manchester. Mr. Gully, Q.C., appeared for the respondents, the Mayor and Corporation of Manchester; Mr. Cottingham, for the Appellant the previous defendant Wardle; and Mr. Sutton, for the Justices.

Mr. Gully: This, Sir, is an appeal by Richard Wardle, who is a farmer in Derbyshire, against a conviction obtained against him at Petty Sessions in Manchester for selling adulterated milk. The Respondents are Mr. John Edwards, who is an Inspector in the employment of the Corporation, and the Justices convicting, Mr. Lister and Mr. Furness. My friends Mr. Cottingham and Mr. Ferguson appear for the appellant, and Mr. Hopkinson and I appear for the Corporation, and Mr. Sutton only represents the Magistrates. The notices have been properly given to us, and I do not put my friend to any trouble upon that; and as the burthen lies upon me to prove the case over again in this Court I will state shortly what the circumstances are. I believe that the real question in dispute between us is one upon the merits. I do not say that it is not open to my friend to raise any point he can, but the substantial one between us no doubt is whether the milk was adulterated or not. That at first sight seems rather a curious point to come upon appeal before you after it has been decided in the Court below; and in this particular case it does raise considerations of some general importance. It seems that on the 23rd April last Mr. Wardle, the Appellant, sent into Manchester a consignment of milk in several cans to a milk salesman named Halewood. Mr. Halewood had, it seems, been dealing with Mr. Wardle since October, 1882, and he had had on previous occasions to complain of the quality of the milk which had been sent to him, notably I think in January of this year; and he had, shortly before the 23rd April, complained to the Inspector that he was getting milk which he believed to be adulterated. The consequence was the Inspector went up with him to the railway station; and, when the milk came in, he went up in the manner required by the Act of Parliament and obtained from the consignment certain samples of the milk. Two samples were taken by him which have been numbered respectively 203 and 204, one from one churn and the other from another churn. The usual formalities required by the statute were complied with by the Inspector—that is to say, he took each sample and divided it into two parts, one of which he sealed up and kept, the other one he handed over in proper form to the Public Analyst of Manchester, Mr. Estcourt, to be analysed. I mean rather to say that he divided that, and gave half of it to Mr. Estcourt and kept the other half himself. The half which was taken on the first division—that is, the half of the whole of each sample—was handed over to the appellant for him to deal with as he thought fit. I think you will find that he had an analysis made of that milk himself; and I shall probably think it right to call before you on their subpœnas the two chemists who did make the analysis at the request of the defendant himself of the sample which he furnished to them. I think it will be found that they bear out the view taken by the Respondents on this appeal—that this milk was adulterated. The milk was analysed, and I had better read the two analyses which will explain themselves: and perhaps, as the certificates are in Court, they might be handed up to the Recorder now. They are addressed to Mr. Edwards, the Inspector.

"I, the undersigned, Public Analyst for the City of Manchester, do hereby certify that I received on the 24th April, 1883, from Inspector Edwards a sample of milk marked 203 for analysis (which then weighed ——) and have analysed the same, and declare the result of my analysis to be as follows;—I am of opinion that the said sample contained the percentages of foreign ingredients following, namely, 4 per cent. of added water. No change had taken place in the constitution of the sample which would interfere in any way with the analysis." That is a clause which under the statute is required to be put into the certificate; and I think you will find that it is a very material clause to be put in with reference to this particular case. "As witness my hand, 25th April, 1883."

Then the other certificate is in precisely similar form I think—4 per cent. of added water. That is the certificate which was handed in; and it would be convenient that I should allude at the same time to what the actual result of the analysis was. Probably you, Sir, will know more of the chemistry of milk than I do, and it would be certainly be difficult to know less. It will be necessary that I should call your attention to what is material in this matter as far as I understand it. It seems that the main constituent of milk is water itself; and that therefore you cannot test whether milk has been adulterated by water simply by trying whether you can discover water in it, because something like 88 per cent. of milk is water. The residue consists of solids which are divided into two different descriptions of solids: solids which are not fat, and solids which are fat. Without going into the details of the matter, which I am afraid I could not describe very clearly, it is sufficient to say that the way of testing it is this: First of all you evaporate the water; and then, by a process which will be described, you get rid of the fat, and so ascertain what the residue is of solids which are not fat: and the question of whether the milk has been adulterated or not is settled by ascertaining whether the due proportion of solids which are not fat exist in the sample. If the due proportion does not exist it shows that the milk in its original state of purity has been tampered with, that is that some of it has been taken away, and in lieu thereof water—to take the case of adulteration with water—has been put in. Water of course would not contain any of these solid matters; therefore there being mixed with the milk a certain quantity of water not containing these solid matters it would diminish the percentage of solid matters over the whole body. What they want to get at is whether or not the proper proportion of solids which are not fat is present; and that is not an absolute constant but a nearly constant quantity in milk. If that proper proportion does not exist in the milk there is an excess of water and it shows that there has been adulteration by water. The result obtained in this case was this as regards sample 203—Mr. Estcourt found there were 8·67 parts of solids not fat, and 2·54 of fat, the rest of the 100 parts consisting of water which was evaporated away. The total of solids was 11·21 and that would leave for water 88·79. Then sample 204 was a sample taken from a different churn. In that Mr. Estcourt found 8·62 of solids not fat, and 2·81 of fat, making total solids 11·43, and leaving of water 88·57. Those were the figures which Mr. Estcourt in his own laboratory ascertained as the analyses of these two samples of milk; and it was upon those figures that he made his certificate that 4 per cent. of water had been added. I may say at once that the basis upon which Mr. Estcourt made that report, and came to that conclusion that there was an addition of water, was that in his opinion there should have been at least 9 per cent. of solids which are not fat. That I think will be found to be not only Mr. Estcourt's opinion, but the opinion universally acted upon by Public Analysts in this country. The abstraction of anything from that figure of 9 indicates the substitution of some other matter, in this case water, and that therefore there had been an adulteration to the extent indicated by the difference between 9 and 8·6, and the amount of that difference in solids indicates by a process of arithmetic about which probably there would be no dispute, an adulteration to the extent of 4 per cent. of water. That was the mode in which the certificate was arrived at. I should tell you the course which matters took in this case shortly, so far as it is material. The case came on for hearing and some evidence of the usual kind was given. Mr. Estcourt's certificate was put in, and that was all that was necessary, according to the Act of Parliament. No doubt Mr. Estcourt was in Court, but whether he was called to give evidence or not I do not know. At any rate his certificate was put in which is sufficient evidence under the Statute until disproved. Upon the other hand the appellant, Mr. Wardle was called, and one of his men, who denied that any water had in fact been put in. Then Mr. Wardle applied to the magistrates as he was entitled to do under sec. 22 of the Sale of Food and Drugs' Act, 1875, to have the sample analysed by the authorities at Somerset House. The appellant having required the justices to have an analysis made by the Commissioners of Inland Revenue, at the hearing, which I think was on the 9th of May, the justices made an order to that effect; and a part of the original sample was sent up to the chemical officers at Somerset House to make an analysis, and that analysis was made on the 16th May I believe. At any rate it is dated the 22nd; and although this certificate is in itself no part of my case, I propose to read it because I think it is only fair to the other side that it should be read; and no doubt you will hear more of it in the course of the case, because it is necessary that I should call some evidence in respect of the processes adopted to shew the relative value of the certificate and analysis made by Mr. Estcourt and that made by Dr. Bell in London. Dr. Bell is a gentleman of great eminence in his profession as an analytical chemist and for reasons which will appear in the course of the case, I shall venture to impugn his certificate, which is as follows:—"Somerset House. The sample of milk referred to in the annexed letter marked 203 was received here on the 10th inst. The bottle was securely sealed. We hereby certify that we have analysed the milk and declare the results of our analysis to be as follows:—Non-fatty solids 8·20 per cent.; fat 2·80; water 89·00; ash ·81 per cent." The latter I understand would be included in the non-fatty solids. "After making an addition for natural loss arising from the decomposition of the milk through keeping,"—that is a most material precaution—"the proportion of non-fatty solids is not lower than is found in genuine milks. The percentages of fat and ash are equal to those found in genuine milks. From a consideration of these results we are unable to affirm that water has been added to the milk. As witness our hands this 22nd May, 1883." This is signed by Dr. Bell and two of his assistants, Mr. Bannister and Mr. Lewin. The next is in form the same, but I will read the details of the analysis. "Non-fatty solids 8·02, fat 3·01, water 88·97, total 100. Ash ·75." In the same way he says there, "After making an addition for natural loss arising from decomposition of the milk through keeping, the proportion of non-fatty solids is not lower than is found in genuine milks." As I said before, in reading the previous certificate, that is a very material point. Before I say anything more about the certificates I will shortly state what the result was. Dr. Bell explained his certificate and his process, and his reasons for arriving at the certificate before the magistrates below, as also did Mr. Bannister and Mr. Lewin. Mr. Estcourt was tendered for cross-examination, his certificate being put in; but the appellant not desiring to cross-examine him he was not put into the witness-box. Other chemists were called to criticise the analysis of Dr. Bell, and in support of the analysis of Mr. Estcourt, and the magistrates in the end came to the conclusion that inasmuch as there were chemists who positively testified that they had analysed the milk while it was fresh and found it adulterated, they could not disregard that or disbelieve it upon an analysis made a considerable time subsequently when the milk was in a state of decomposition by Dr. Bell, especially as Dr. Bell was unable to affirm that the milk had not been adulterated; and taking that view the magistrates then convicted the Defendant. That is the history of the case. Now I will just say a few words upon the discrepancies which do exist, merely adding this before I deal with that question: that parts of the original sample taken by the officer, Mr. Edwards, and handed back by him to Mr. Wardle the appellant were handed by Mr. Wardle to two other chemists, who are also Public Analysts, I think—Mr. Wilkinson and Mr. Hehner. They analysed it before decomposition had set in; and they, not knowing what Mr. Estcourt's results were, and being in fact employed by Mr. Wardle for the purpose of analysing this milk, came to a conclusion entirely confirming Mr. Estcourt and differing from Dr. Bell. The appellant was cross-examined about Mr. Wilkinson's analysis in the Court below, and he admitted that much. I shall be in a position to call before you both Mr. Wilkinson and Mr. Hehner to show what I have just stated. There is a discrepancy as you will observe between these analyses—I will leave out for the moment the question of fat and the total solids, and confine myself to the material point, the solids which are not fat. As regards the sample 203, there is a difference between Dr. Bell and Mr. Estcourt. Dr. Bell, before he made any addition or calculation with respect to the effect of decomposition or any allowance therefor, says that he found in fact in the sample which was before him in May, 21 days or more after the milk had been seized, 8·20 per cent of solids not fat. Mr. Estcourt says he found 8·67. Now assuming that the processes were precisely the same, and assuming that there was no allowance to be made in respect of the decomposition of the milk having taken place, that of course would do more than confirm Mr. Estcourt's view; and it would be difficult to understand how Dr. Bell could say that that did not indicate adulteration. Dr. Bell's own evidence is that by his own process he found solids not fat only to the extent of 8·20; and I think from what Dr. Bell said in the Court below that he would be prepared to admit that that must have been adulterated. Then Dr. Bell gets over that difficulty—I am only using the phrase as meaning a scientific explanation—he explains the difficulty in this way: he says he was experimenting upon a sample that was decomposed, and that the effect of decomposition is to get rid of a certain quantity of solid matters which are in this fluid milk when it is fresh; and therefore in order to calculate what the milk was when it was fresh, or to borrow a phrase which I understand chemists sometimes use, in order to build up the fresh milk again you have to add something which your experience or your science teaches you is the proper thing to add in order to turn it into fresh milk again. Dr. Bell says I have done that; I have added something to the 8·20 in order to bring it up to what was the true fresh milk at the time when it really was fresh, that is, in order to bring up that milk which I am now analysing in a decomposed state to the point at which it was when fresh, I add ·4 that is to say 4/10ths per cent. for that loss in 21 days and by that means bring it up to 8·60. Now the process which Dr. Bell uses is a process somewhat different from that used by all these gentlemen who are Public Analysts, and by the Society of Public Analysts, which treats these questions as questions of very great importance; and by Dr. Bell's process I believe 8·67 corresponds as nearly as we can put it to 9·00 of solids not fat by the process used by the Public Analysts. Therefore, if as I understand 8·67 or 8·60 by Dr. Bell's process was the result as regards solids not fat, that would represent substantially 9·00 of solids not fat according to the process of the Public Analysts; and if the milk did contain 9·00 per cent. of solids not fat Mr. Estcourt would not condemn the milk. But let me go back for a moment. In order to get at that 8·60 and to bring the milk into an innocent condition Dr. Bell has added a figure for which we say there is no scientific basis whatever—he has added to the 8·20 4/10ths per cent. of solid matter; and he says that he puts in that as representing the loss. It is not a thing that he actually finds in the milk at all. He says that he does not find that solid matter and that he has no evidence of it in the milk at all; it is merely a calculation; it is really a guess at what the solid matter was in that milk. I will tell you why I use the word "guess." I use it advisedly. There is undoubtedly a loss from decomposition which takes place. At what particular moment that decomposition will set in in particular milks, or how long it has been going on in a particular sample at the expiration of 21 days it is impossible to tell. In some cases it sets in much earlier than in other cases; in some cases it sets in very rapidly, in others more slowly; and it is impossible to tell with any accuracy what the amount of decomposition is. I shall show you by evidence of very experienced gentlemen, which I think you will attach considerable importance to, that they have tested milk which was in a state of decomposition and compared the analysis of that with the analysis of a part of the same sample taken when fresh, and they have found that no loss has taken place; while at other times with other samples they found that there had been a considerable loss. What does that lead to? It leads to the result that an analysis of milk in a state of decomposition is utterly unreliable. It may or may not be correct; but it is utterly unreliable; and according to a number of Public Analysts, who I shall call before you upon this short point, they will tell you that they would never think of testing, or judging by an analysis made of a sample o milk after decomposition had set in, an analysis of the same milk made by a competent person when the milk was fresh. You may add a figure, it may possibly be the right figure; but you have no means of ascertaining whether it is the right figure. Even if you could assume that there was an average, if you could ascertain by any experience what the average was, which is really all that you could do, it would be no means of testing whether an analysis taken of fresh milk at the time it was fresh is right or not. You cannot test it by what the average of loss three weeks afterwards is. It may be that in that particular case there has been no loss at all; it may be a case in which the loss has been double the average. You have therefore no means of testing it; and to say that you have tested it by an average is to pass no judgment at all, as it seems to me, in a case in which analysts have analysed the milk when fresh. Therefore this is a case which is of considerable importance: because the Public Analysts, Mr. Estcourt among them, are in the habit of testing milk properly at the time when it ought to be tested, namely, when it is fresh, which is the only time when you can take really reliable tests; and if the results arrived at, not merely by Mr. Estcourt, but in this case by independent Public Analysts acting really under the instructions of the appellant himself, from analyses made of the milk before decomposition had set in show that there has been adulteration, and shew results which I think Dr. Bell himself would have to admit prove that there was adulteration, are they to be set aside by a test taken by a chemist, however eminent, some three weeks afterwards when decomposition had set in, because he says not "I will affirm that it is impossible that Mr. Estcourt's results are correct," but "I am unable to affirm from my examination of this decomposed milk that there has been adulteration?" The matter is one of very considerable importance, because although 4 per cent. of water is not in itself a very large quantity, it represents on the consumption of Manchester, I am told, something like £10,000 a year—that is to say that if all the milk sold in Manchester were adulterated to that extent it would represent £10,000 a year on the consumption of Manchester. It is impossible to say that this 4 per cent. is the limit of the adulteration in this particular case. What these gentlemen say is, that it has been adulterated to the extent of at least 4 per cent.

The Recorder: What do you say was the object of the Legislature in making this *quasi* Court of Appeal at Somerset House?

Mr. Gully: If you ask me what the object was, I can only answer that I believe the object was the same as that with which many clauses are put into Acts of Parliament. There are many conflicting interests in Parliament, and some County Member, having in view the interests of the farmers, has some theory about the matter and gets this clause inserted, thinking it will protect his constituents, and the Minister in charge of the Bill does not object, thinking it will do no harm. Nobody sees how many days it will take before the milk can reach the hands of the chemists at Somerset House, but when the Act is put in force it is found that there is very serious difficulty. I say that the evidence from Somerset House is to be taken for what it is worth. Of course, if it were not open to any comment which ought to have weight with the Magistrates, and they found a conflict between two chemists, they would say that in the face of that conflict of testimony they ought not to convict. I quite agree; but at the same time it is to be taken as a piece of evidence which is to be considered and dealt with like other evidence; and if it can be shewn, as we did shew to the satisfaction of the Court below, that this discrepancy is accounted for in a way which is not only consistent with the analysis of Mr. Estcourt being a correct one, but consistent also with Dr. Bell's analysis when you take out what is unreliable in it, then it is to be dealt with like you would deal with any other evidence given by any other witness, and it should be set aside if you do not think it is valuable as compared with the evidence of the other side.

Mr. Cottingham: I think now is the most convenient time to draw your attention, Sir, to one of the grounds of appeal in order to raise a question of law upon it which you have just at this moment touched. It may shorten the case if I read the third ground of appeal, "That the said Court of summary jurisdiction having exercised the discretion vested in them by section 22 of the Food and Drugs Act (38 and 39 Vict.) 1875, and obtained a certificate from the chemical officers' department at Somerset House, were bound by the contents of such certificate and ought not to have convicted me." That is our third ground of appeal. It has evidently struck the mind of the Court that the legislature must have had some object in view in introducing this clause. Before I go into the object of the clause, it is quite apparent that the clause for whatever purpose introduced would become a dead letter if my friend Mr. Gully's argument were to prevail as to the length of time between the taking of the sample and the sending of the sample to Somerset House, because this 22nd section assumes that a prosecution has been commenced, the samples have been analysed by Public Analysts and that the defendant is upon his trial; and either he or the prosecution may request the justices to send another sample to Somerset House for the purpose of analysis. That being so it is evident that the Act of Parliament assumes that a considerable interval will elapse, and an interval too which is entirely at the option of the prosecutors; because they may delay the prosecution for a considerable length of time. This provision would become a dead letter.

The Recorder: Not quite. What struck me when Mr. Gully was addressing the Court was that it may be that this appeal under the circumstances is not conclusive. It may be that the legislature intended that protection should be thrown over the dealer in milk against some grossly ignorant conviction upon some grossly ignorant analysis; and if the local analyst had said there was 10 per cent. of water, or 20 per cent. of water, or 30 per cent. of water, and the Somerset House analysts said that is all nonsense, there is nothing of the sort, that would of course be conclusive, not in law, but in the mind of the justices. However, let us look at the exact words. What you say, as I understand, is that the appeal to the Government analyst is conclusive?

Mr. Cottingham: I say that it is conclusive and binding upon the justices.

The Recorder: Now let us look at the words of the Act of Parliament.

Mr. Cottingham: Section 22. The marginal note is "Power to justices to have articles of food and drugs analysed." Then the section itself is "The justices before whom any complaint," &c. So that in point of fact you are sitting here to-day, months after the samples have been first taken, and the milk would now be in a state of putrefaction, yet we might ask you now to send a sample to Somerset House for examination. Then what becomes of my friend's argument as to the inutility and the imperfection attending Dr. Bell's analysts only a few days after the sample was taken when there was only incipient decomposition. You might now order samples of this milk to be forwarded to Somerset House; therefore the law must have contemplated that an indefinite interval should elapse between the sale of the milk and the examination of the samples at Somerset House. It is true that the section does not say in express terms whether it should be binding or not. The only provision is that the justices may inflict the costs of the examination by the officials at Somerset House upon either of the parties. Now, my friend has said that some county member may have introduced this clause.

The Recorder: I am bound to suppose that the legislature has done nothing that is not absolute wisdom.

Mr. Cottingham: Allow me to draw your attention, Sir, to the reason why this clause was introduced. This Act of Parliament of 1875 underwent considerable discussion in Committee. There was a report made upon it by a Committee; but during the examination several attempts were made to establish a standard such as my friend is contending for now, and after various attempts had been made it was found impossible. I have the Blue Book here; and after examining Dr. Voelcker, Dr. Bell, and all the most eminent chemists in England, and some foreign chemists also, the committee found that the adoption of any standard was impracticable; but in substitution for a standard they introduced this 22nd section as a sort of appeal to the Government analysts, who are supposed to be and necessarily are perfectly independent in the matter, and who were intervened in a case of difficulty such as this. The committee with great wisdom and in accordance with the great weight of the scientific evidence adduced before them were unable to and would not adopt a standard.

Mr. Gully: I am quite prepared to cite from Hansard on the other side of the question. I have Hansard, and my friend has the Blue Book; but I quite agree that you must decide upon the words of the Act itself.

The Recorder: I quite agree with you, Mr. Gully, as to the interpretation of the section. It seems to me perfectly clear what the section is. The section is that there is to be a reference to the chemical officers of that particular department at Somerset House. They must make an analysis and give a certificate to such justices of the result of the analysis. It is not to bind the justices; but it must clearly be one of the matters which the justices are to take into consideration in coming to their decision.

Mr. Gully: Take this case for illustration—that a man had admitted that he put the water in afterwards?

The Recorder: Yes, there is no doubt about it.

Mr. Cottingham: This is the evidence given by a very eminent analytical chemist, Dr. Stevenson Macadam. He was asked "Do you not think that being a Government department it would be better than almost any other court of appeal could be?" This is his answer, "I think if we had the processes thoroughly worked out, and authenticated processes submitted for working out the Act, Somerset House might be a court of appeal; for, so far as the range of analytical work is concerned, they certainly are competent to do it; but I am still in a little difficulty as to whether they are the proper parties to frame processes for the analytical examination of all the articles under the Food and Drink Act."

The Recorder: I can only look to what the legislature enacted; I cannot decide the case upon the opinions which were given to the legislature before they formed their judgment.

Mr. Cottingham: I want the Court to take notice of this: that attempts were made during the progress of this bill through committee to establish a standard; and the attempt to establish any standard as to non-fatty solids from which to draw a conclusion as to adulteration of milk entirely failed; and in substitution for that standard they have introduced this 22nd section in order to allow the analysts of the Government to intervene. However, you hold that it is not binding?

The Recorder: I have no doubt about it, looking at the Act of Parliament. There is no necessity for sending it on to the justices if the sending the sample to Somerset House were intended to be conclusive.

Mr. Cottingham: You see that no time is fixed for the sending of the sample to Somerset House; and any interval of time may be supposed to elapse from the taking of the first sample to the time of the sample being sent there; therefore the legislature assumes that the milk would be in a different state when it reached the Government analyst to that which it was in when it was tendered to the public analyst for examination.

Mr. Gully: The section is not only about milk, but about any food or drug. Milk is perhaps the only article that would so decompose.

The Recorder: If you want a decision I clearly hold that the third ground of appeal is not good in law.

Mr. JOHN EDWARDS, SWORN.—Examined by Mr. Hopkinson:

Q. I think you are one of the Nuisance Inspectors of the City of Manchester? A. I am.

Q. And you deal with questions under the Food and Drugs Act? A. Yes.

Q. Do you remember in the early part of this year receiving complaints from Anthony Halewood, a milk seller of this city? A. Yes.

Q. In consequence of those complaints, did you on Monday, the 23rd April, go to the Central Station? A. Yes.

Q. Did you, about 8.20 in the morning, take samples of milk from two cans of milk which came by the train? A. I shall have to look at my book to tell the time. Twenty minutes past 8 in the morning.

Q. Did you take samples from two cans arriving by train? A. Yes.

The Recorder: Does not this case come to a point at which there is no dispute as to all this? It is merely a question of whether the analysis is correct or not.

Mr. Cottingham: I will shorten it as much as I possibly can. No doubt what you suggest, Sir, is most important; but I must hear what this gentleman has got to say.

Mr. Hopkinson: Did you, before taking the samples, mix the milk? A. I mixed the milk well up.

Q. What did you do with the milk cans? A. I got a "dozen" cans, and poured from the large railway can a quantity into the dozen cans, then dashed it back again. That was repeated twice over.

Q. And after that what did you do? A. Then I took a sample from each of the two cans.

Q. What did you do with the samples? A. I divided them into two parts, and sealed and labelled each one.

Q. What did you do with the parts? A. One I delivered to Mr. Estcourt, the Public Analyst, and the other I kept at the office until Mr. Wardle came for it.

Q. Did you produce those samples that you sent to Mr. Estcourt, at the hearing before the magistrate? A. Yes.

Q. And those were afterwards sent to London, I think? A. They were. I believe they were handed in by me to the Court.

The Recorder: I shall assume that all this was done correctly, and leave Mr. Cottingham to point out any inaccuracies that may have been fallen into by this witness.

Cross-examined by Mr. Cottingham:

Q. This milk was contained in two large cans, which they call churns? A. Yes.

Q. The milk was not in charge of the Defendant, Mr. Wardle, or in charge of anyone on his behalf other than the Railway Company? A. No one else but the Railway Company.

Q. How did you get access to the cans? A. As soon as the train arrived the cans were pointed out to me as being the cans belonging to Mr. Wardle.

Q. Of course you opened them. Was the lid locked, or what? A. No, Sir, they were not locked.

Q. So that you opened the cans without difficulty? A. Yes.

The Recorder: Which contention are you going to rely upon: are you going to say that this milk had had water put into it after it left the appellant's premises, or are you going to say that the milk, as examined by this man, was pure?

Mr. Cottingham: I say there is no evidence of impurity at all. That is, of course, the evidence on the analysis; but I want to ascertain how the sample was taken. A question will arise as to the milk he took—he took only morning's milk, as you will see, and that is what I am coming to.

The Recorder: Of course both grounds of defence are open to you: but if you are going first to shew that this water had been put in previous to the analysis, that will, of course, render futile any attempt to shew that the milk was pure.

Mr. Cottingham: I am not going to assert that at all; it may or may not be; I make no point of it. I want to shew the Court how the milk came to Manchester, and how this man got to it. I have only a question or two more to ask upon this:

Q. You opened the can without difficulty, and you took out the milk. About what quantity did each of those churns contain? Mr. Wardle: 17 imperial gallons.

Q. About how much of the milk did you pour out for the purpose of mixing it and pour back again? A. I filled the dozen-quart can, and poured it back again twice.

Q. You did not see Mr. Wardle, and you did not see any person on his behalf? A. No.

Q. You took it as an Inspector? A. I did.

Q. You did not pay for it? A. No.

Mr. Cottingham: I ask that because my friend, Mr. Gully, opened that there was a sale.

Mr. Gully: Then I will withdraw it. I do not know whether my friend admits that this was milk which was being delivered to Halewood under a subsisting contract to supply the milk?

Mr. Cottingham: This was milk that was being delivered to Halewood under a contract. We admit that the whole of the two cans formed one consignment under a general contract.

Mr. ANTHONY HALEWOOD, sworn.—Examined by Mr. Gully:

Q. Had you a contract with Mr. Wardle to supply you with milk? A. Yes.

Q. Had that been going on for a long time? A. Since October, 1882.

Q. Was he to send you all his milk, or so much a day? A. The produce of his farm—all his milk.

Q. Had you found it of good quality or not? A. No.

Cross-examined by Mr. Cottingham:

Q. You say you had a contract for this milk. At what price? A. In summer it was 1s. 11d. before October.

Q. What in the other parts of the year? A. 10d. per gallon for the winter months.

Q. Those gallons are not imperial measure? A. Imperial measure.

Mr. CHARLES ESTCOURT, sworn.—Examined by Mr. Gully:

Q. Are you a Fellow of the Chemical Society, and Public Analyst for the City of Manchester, and also for Oldham? A. Yes.

Q. Were those two samples, Nos. 203 and 204, handed to you by the first witness? A. They were, on the 24th April.

Q. I want to take it shortly. Were they made up in the usual way in which samples are made up? A. They were.

Q. Did you analyse them? A. I did.

Q. On what day? A. On the same day.

Q. On the 24th April? A. Yes.

Q. How soon after you got them? A. Each was put into operation immediately. I received them on the 24th, and analysed them on the 24th.

Q. And you made out your certificates on the 25th, and those are they which have been put in and read? A. That is so.

Q. Would there be any change in the milk on the 24th which would affect in any way the analysis? A. None; they were fresh.

The Recorder: They were fresh when you analysed them? A. They were fresh.

Mr. Gully: Have you got the details of your analysis? A I have.

Q. Just give them shortly to the learned Recorder. A. Sample 203—solids, not fat, 8·87.

The Recorder: That is non-fatty solids? A. Yes, non fatty solids—fat 2·54. Sample 204—non-fatty solids 8·62.

Mr. Gully: Finish with the first sample—total solids 11·21? A. Yes, 11·21 total solids. No. 204—8·62 solids not fat, and 2·81 fat.

Q. That makes 11·43? A. 11·43 total solids.

Q. Of course the balance 88·57 would be water? A. Would be water. 11·43 is the total solids.

Q. And we may leave the water out of consideration altogether? A. Yes.

Q. Whatever is not solids not fat, or fat, is water? A. That is so.

Q. Is the fat a matter that it is material to consider in this analysis? A. It is not.

Q. That may be left out? A. That may be left out in calculating the amount of water.

Q. That may affect the richness of the milk, the amount of cream, or fat, I suppose? A. Quite so.

Q. But it is by estimating the amount of solids not fat, that you ascertain whether there has been adulteration by water? A. Yes.

The Recorder: You ascertain it by the quantity? A. By the quantity of solids not fat; that is how we ascertain adulteration with water.

Q. That would not apply to anything else? A. No; skimming would be ascertained by the amount of fatty solids.

Mr. Gully: The solids not fat consist principally, I believe, of casein and albumen? A. Casein, milk sugar, and mineral matter.

The Recorder: What is casein? A. Curd, which, with fat, makes cheese—the cheesy matter.

Mr. Gully: In testing whether there has been adulteration, you have first to get rid of the water? A. Evaporate the water away at the temperature of boiling water as nearly as possible.

Q. I think you had better describe what you do. You first of all evaporate the water. How do you do that? A. You weigh the quantity of milk, place it in a small vessel, which is placed upon a water-bath with steam impinging upon the bottom of the vessel. That evaporates the water away.

Q. How long do you subject it to that? A. Three hours.

Q. By that time the water is evaporated? A. By that time it does not sensibly lose weight—it is dry by the time.

Q. What is left is not affected by the steaming? A. That is so. I had better explain that, you may go on drying it for any length of time; it will continually lose a very small quantity. The method pursued by Public Analysts is to weigh it at the end of three hours.

The Recorder: Is this method impugned?

Mr. Cottingham: Certainly. We say that this method is entirely obsolete, and founded upon a false basis.

Mr. Gully: "Obsolete" means by the other side?

Mr. Cottingham: It is obsolete in the opinion of all practical scientific men, Dr. Voelcker among others.

Mr. Gully: When you have evaporated the water, you proceed to get rid of the fat? A. Yes; we use any fat solvent, and that is poured upon the milk solids which are left in the vessel, and it is heated on the bath; and then the liquid portion is decanted off.

Q. And you pour on ether, I believe? A. Petroleum ether; ordinary ether will do, or benzoline. That is poured upon it, and then decanted off, and it gradually takes away all the fat.

Q. You mean that you strain it away? A. You pour it off. The method of analysis differs from the one Mr. Cottingham will bring forward, I suppose. Inasmuch as the material is not detached from the vessel, therefore we only pour it off. If it were detached from the vessel we should have to filter it. We do not powder it.

Q. By means of ether you separate the fat from it? A. Yes, that is so.

Q. Leaving a residuum of non-fatty solid matter? A. Yes.

Q. That you found to be 8·67 in the one case and 8·62 in the other? A. That is so.

The Recorder: Can you tell me how it happens that the analyses were different when these two samples of milk were taken from the same churn, or from a portion of two churns mixed together? A. I am afraid the last witness has not put the case clearly if your Honour understands that to be the case. The milk was not taken from two churns mixed together. Each of those samples was taken from separate churns. Those separate churns, from the method adopted at most farms, are likely to contain milk of different cows.

The Recorder: That has cleared up what I wanted to know.

Mr. Gully: Sample 203 you understood to be a sample from one can? A. I understood the evidence to be so; but I have nothing but the numbered sample.

Q. And sample 204 from another can? A. Yes. There might be a greater difference between the two cans even than there is.

Q. One can might contain the milk from one dozen cows, and another can the milk from another dozen cows? A. Quite so.

Q. Which may account for the small discrepancy? A. Yes; and there might be a larger discrepancy. There frequently is from cans from the same farm.

Q. Your difference is ·5 per cent. between the two? A. It is 5/100ths.

Q. ·05 I mean? A. Yes.

Q. You have described the method. You are a Member, I believe, of the Society of Public Analysts? A. I am,

Q. Is that a Society to which most of the Public Analysts of counties and boroughs belong? A. It is; and a large number of other analysts also belong to the same Society.

Q. You have great experience in analysis of milk? A. I have—500 samples per annum for the last two years, and 400 samples for the previous five or six years.

Q. Is that including experiments for your own satisfaction? A. Yes.

Q. Is the system you have described that which you follow? A. It is; and it is in general use among Public Analysts.

Q. As the result of your general knowledge and experience, which do you find to be the best and safest method of analysing milk? A. The one originally adopted, and generally adopted by Public Analysts.

Q. Does 8·67 and 8·62 shew adulteration in your opinion? A. It does.

Q. To what extent? A. I calculated it out to the extent of 4 per cent.—that is calculating it to the lowest limit which the Public Analysts found from a dairy of cows, when their method was followed, which is 9 per cent.

Q. I do not understand that? A. The lowest amount of non-fatty solids that has been found on an analysis of genuine milks by the method adopted by Public Analysts is 9 per cent. That is the standard I take.

Q. Any milk shewing a less amount of solids not fat than 9·00 per cent. shews adulteration? A. It does.

Q. To work out how much water that shews is only a matter of arithmetic? A. Quite so.

Q. You say that the difference—the 4 per cent. was water? A. 4 per cent. of water.

Q. You can shew how you work that out if you are asked? A. Yes.

Q. You say that 9 per cent. is the standard, so to call it, that you take? A. It is the minimum. It is rather a limit than a standard; it is the limit below which the Public Analysts did not deem it advisable to permit the addition of water to milk.

Q. What do you find is the actual quantity of solids not fat in pure milk? A. I have made a series of analyses of milk from cows milked in my own presence; 173 cows gave an average of 9·3 milked in my own presence.

Q. They were milked in your own presence, but did you see the milk put away yourself that was to be sampled? A. Yes, I carried it myself.

Q. Is that of importance in your opinion? A. That is very important. I may say that I was assisted in some cases by four inspectors. It would be impossible to see a dairy of cows milked if one person only were to supervise it. If the object is to prevent the introduction of water one person could certainly not do that.

Q. That has all been done under your own personal 'superintendence, and what did you find the result was there—what was the average of solids not fat? A. 9·3 the average. The fat is also very high— 3·68. There was nearly 13 per cent. solids.

Q. In how many different farms were those cows—or was it one dairy? A. They were in 17 different shippons, 6 different farms in Cheshire and near Manchester; the cows were stall-fed and grass-fed and all varieties; some morning's milk and some evening's milk.

Mr. Gully: Did you find that the cows being stall-fed or grass-fed made any difference in the amount of solids not fat? A. I have two samples here—the first of a lot of six shewed 10·52. That is one of the samples of grass-fed and 9·17 is the lowest there. Then I have stall-fed. 9·1 is the lowest and 9·44 is the highest of the stall-fed. This was a large farm near the town—near Manchester.

Q. What do you find those range from? What do you find are the limits of the range altogether? A. From 10·52 down to 9·01.

Q. That is the lowest of 173 cows? A. That is the lowest. There are 95 more cows which were not milked in my presence but in the presence of our inspectors.

Q. You say they were not milked in your presence? A. That is so, but I have analysed those.

Q. And no pure milk ought to contain less than 9·00. A. That is so. I did not find a single dairy less than 9·00.

Q. Have you made many experiments with the same view before, besides your large experience in analysing for cases of this description? A. Yes.

Q. Do you find that pure milk always contains at least 9 per cent.? A. That is my experience and there were very few cases where I found it as low as 9.

Q. Did you make the analyses of 203 and 204 in precisely the same way in which you have made all others A. Precisely.

Q. Speaking as a scientific man have you any doubt that those were adulterated to the extent of 4 per cent. with water? A. From my experience of the milk of cows I have no doubt whatever.

Q. Have you experimented also upon milk when it has been fresh and pure and upon the same milk afterwards when it has become decomposed? A. I have.

Q. Do you find that you are able to test the one analysis by the other. A. No. I find from my experience that it is impossible. There is no relation between the length of time and the decomposition.

Q. In the first place the setting in of decomposition I believe does diminish the amount of solids not fat? A. It does. The sugar is acted upon principally.

Q. The longer the decomposition goes on and the greater the amount of decomposition the greater the diminution? A. That is so.

Q. Is there any precise rule as to when decomposition sets in or as to what its rate is? A. None whatever. It would depend upon the temperature and the condition of the milk, the conditions as to keeping, upon whether the milk had been watered or was pure—all those affect the rate of decomposition.

The Recorder: And the state of the atmosphere? A. Quite so. If you take a sample of perfectly pure milk, and water it and put a portion of the pure milk by and a portion of the adulterated by, at the end of seven days you will find a difference in the rate of decomposition.

Mr. Gully: If it has been already adulterated with water it will decompose at a different rate to a portion of the same milk which has not been so treated? A. Yes.

The Recorder: How fast or how soon? A. There is no law which governs it apparently.

Mr. Gully: Have you been able to ascertain any rule about it? A. I have not.

Q. Except that decomposition does tend to diminish the weight of solid matter? A. It does. I may mention that ten years ago it was attempted to estimate the solids in milk decomposed by neutralizing it. A paper was written at the time, but it was proved that it was totally unreliable.

Mr. Cottingham: Whose paper was it? A. Dr. Stevenson's. It is in the Society's proceedings.

Mr. Gully: Your opinion is that tests of decomposed milk are not reliable? A. I could and would pronounce no opinion as to results of any analysis of decomposed milk.

Q. Would you condemn decomposed milk on an analysis? A. I should say I was unable to pronounce an opinion upon it. I do not mean simply turned sour, but decomposed.

Q. I understand that Dr. Bell by his analysis brings out 8·20 and then he adds a certain amount. A. From a table in his book.

Q. Dr. Bell has written on this subject, therefore you are familiar with his views no doubt. A. I am.

Q. And you heard what he said before? A. I did.

Q. He added 4/10ths to make it up to fresh milk? A. Yes.

Q. Is that in your opinion a process that can be relied upon? A. I fail to see how he can apply that 4/10ths to the milk he analysed. That 4/10ths may be a proper average, it may apply to some particular milk; but there is no possibility of applying it to any special milk.

Q. It may or may not be a proper average upon a number of experiments? A. Yes.

Q. But would those experiments shew a very great range of difference? A. Yes, they would.

Q. Would some shew no alteration? A. Undoubtedly.

Q. And some a very great change? A. Yes, much beyond the allowance there even.

Q. Dr. Bell brings it out in the first instance at 8·20. Does he use the same process that you do? A. I judge not from the book in which he published his process. It is entirely different.

Q, You know what Dr. Bell's process is? A. I do.

Q. Is that the same process as yours? A. It is not.

Q. Would that bring out the same result in figures of solids not fat if you and he were both to analyse precisely the same milk. A. It would not.

Q. If you brought out for example 8·67, what would you expect his analysis to bring out? A. I should judge it would be uncertain.

Q. Then you do not think his as certain a method to begin with as your own? A. I think not. I may be allowed to point out the reason, perhaps?

Q. Yes. A. It is simply because the milk is not dried thoroughly, but is left in a pasty condition in Dr. Bell's method, and then ether is added to that for the purpose of dissolving out the fat. The milk being in a pasty condition when it was done, water would be there, and the effect of ether being added to the water would be to dissolve out some of the sugar. The ether will not of itself dissolve the sugar, and the effect of putting it on when water is present is to decrease the solids not fat, and increase the fat. This will vary according to what may be the pasty condition, and when analysing what may be a pasty condition to one man would not be a pasty condition to another.

Q. Do you find that he brings out more fat than you do in your analysis? A. I have looked through the series given by him, and find that the fats are always high. You will find there is an increase of fat in both cases—Nos. 203 and 204.

Cross-examined by Mr. Cottingham:

Q. Can you tell us about this Society of Public Analysts: how long it has been in existence? A. I think since somewhere about 1874 or 1875.

Q. It came into existence perhaps a little before the passing of the Act of 1875? A. It came into existence immediately after the passing of the Act, which appointed Public Analysts. It could not exist before.

The Recorder: After the passing of the Adulteration Act? A. Undoubtedly.

Mr. Cottingham: Was it in existence at the time that this bill of 1875 was passing through Committee? A. It was.

Q. This minimum standard of 9 per cent. is what is called the Wanklyn standard? A. Public Analysts' limit.

Q. Was not that 9 per cent. standard introduced by Mr. Wanklyn? A. Professor Wanklyn first observed the constancy of milk solids not fat.

Q. When was that 9 per cent. established for the first time? A. It would be at a meeting of Public Analysts.

Q. When? A. I cannot call it to mind: it would be 1874 or 1875.

Q. It is founded I believe upon an average? A. By no means.

Q. Do you understand?

The Recorder: Mr. Cottingham, he perfectly understands. He says it is not founded upon an average; it is a limit.

The Witness: It is not an average. The average would be very much higher than that.

Mr. Cottingham: How do you get at that?

The Recorder: He has explained. I should be sorry to lecture upon such matters, but I think I understand him. He says that it is not an average, it is a limit; and no good milk would have less than 9, and that the average of the contents of good milk would be somewhat higher.

The Witness: That is so.

Mr. Cottingham: Will you explain to me how this 9 per cent. is arrived at? What is the process by which it is arrived at?

The Recorder: It is arrived at in the way he has explained. I do not say that it is right, but he has explained it; and by a series of experiments he has made, he finds that in no pure milk is there less than 9 per cent. of non-fatty solids.

Mr. Cottingham: I will put it in another way. At all events the mode in which it was arrived at by Wanklyn, and also by you, was by treating a small portion of the milk in the way you have described. You dry it for about three hours? A. That is so.

Q. In these experiments and these analyses did you first weigh the total solids. Then having done that you extracted the fat? A. Yes.

Q. Did you weigh the fat? A. No.

Q. Did you extract the fat by treatment with ether? A. Benzoline, or petroleum ether.

Q. Then what did you do with the residuum not fat? A. The non-fatty solids were dried then.

Q. How were they dried? A. In the water-bath.

Q. How long were they submitted to the drying process? A. Three quarters of an hour.

Q. Did you weigh then? A. I weighed them.

Q. I did not understand you to say that you dried either the fat or the non-fatty solids to a constancy? A. Yes, there were weighings in between, and when they had practically ceased to lose weight.

Q. Never mind practically. Did you dry either the fat or the non-fatty solids down to a point where they could lose no more weight by the process of drying? A. What limit? When they ceased to lose 1/100th of a grain I should say they were practically constant.

Q. Do you mean to affirm as a matter of science that you dried the fatty or non-fatty solids down to a point at which they could not lose any more? A. I should say 1/100th of a grain would be a limit. ·01 would be the loss probably when you had dried down for three hours.

Mr. Gully: Do you mean there would be only that left to lose? A. That would be the loss in the weighings at intervals of half an hour probably.

Mr. Cottingham: That was the result of your three hours drying of the fat? A. Three hours drying of the total.

Q. You say you extracted the fat and you dried the fat three hours? A. No.

The Recorder: Not fat; the total solids? A. I dried the total solids for three hours and then extracted the fat and dried what was left for three-quarters of an hour.

Mr. Cottingham: You weighed the total solids. Why did not you weigh the fat? A. It is a matter of arithmetic. If I weighed the fat I should not weigh the solids not fat, because the loss of one leaves the other.

Q. You first weighed the total solids and then you extracted the fat. I want to know why you did not weigh the fat that you extracted? A. I find the other method is accurate.

Q. There is a more modern method of analyis than that which you adopt. Supposing that you had dried both the fat and the non-fat to a constant weight, would not that have given you a different result from the 9 per cent. on the same milk? A. Yes.

Q. That is to say that the same milk treated by the modern method of drying would shew less per cent. of non-fatty solids? A. It is not a modern method.

Mr. Gully: That is your word, Mr. Cottingham.

Mr. Cottingham: We will call it the other system? A. No, *a* system.

Q. At all events it is not your system? A. It is not and it is not the system adopted by Public Analysts.

Q. You will not be surprised to hear that it is the system of the Government Analysts? A. I understand it is from the book.

Q. You admit, as I understand, that if you proceed by the other mode in vogue with the Government Analysts you would have come to a different result—you would have got less non-fatty solids from the same milk? A. Less solids.

Q. Would you not have got less non-fatty solids by that other method? A. No doubt.

The Recorder: Why? A. If it loses $\frac{1}{100}$ of a grain in half-an-hour it would possibly lose in the course of drying a certain amount of organic substances which decompose to some extent on heating. That was one object in the method adopted by the Public Analysts—to avoid that, and to have one settled way of doing it.

Q. What would be the difference of non-fatty solids arrived at by the two different processes? What would be the difference in weight? A. That I cannot say. Milks would possibly decompose in a different way on heating strongly and for a long while—they lose water of constitution.

Q. You say you found 4 per cent., or you deduct 4 per cent. of water. Did you apply any test whatsoever except the presence of the minimum 9 per cent.? A. I did not.

Q. No difference in the specific gravity of the milk? A. I did not take the specific gravity.

Q. What was the quantity—how many grammes did you analyse? A. 100 grains was the quantity I used.

Q. Now as this 4 per cent. of water. That is a very small amount of adulteration is it not? Yes, it is.

Q. Supposing a trifling mistake of a few grains in weight to be made, it would make a corresponding difference in the amount of adulteration? A. It would. A mistake of 10 grains would make a difference of 10 per cent.

Q. 10 per cent. of water? A. Yes.

Q. A mistake of 10 grains in the weight would make the difference? A. Yes.

Q. You did weigh, but you did not measure? A. I weighed and delivered it into the basin with a measure. I always weigh. The calculations are all made upon weight.

Q. Did you perform this analysis on duplicate? A. I did.

Q. You know Mr. Otto Hehner? A. Yes, he is here.

Q. He is called on your side? A. Yes.

Q. I hold in my hand numbers of a paper called THE ANALYST. I believe it is published very much under the protection of the Public Analysts? A. It is the Society's Journal. You may take it that it represents the opinions of the Society largely.

Q. Just give me your attention to this. Here is a paper read by Mr. Otto Hehner in April, 1882. I ask you do you agree with it?

Mr. Gully: I will call Mr. Otto Hehner.

Mr. Cottingham: I am cross-examining this gentlemen. This is the paper—"On Some Points in Milk Analysis. By Otto Hehner, F.C.S., F.I.C. Read before the Society of Public Analysts' on 15th March, 1882." (ANALYST, vol. vii., page 60.)

Q. Do you agree with that? A. If you alter the method you alter the limit; then I quite agree.

Q. If you had dried for six hours there would have been the difference between 11·27 and 11·21? A. There is no difference at all there.

Q. The result at the end of three hours was 11·27, and at the end of six hours 11·21? A. A difference of $\frac{6}{100}$. I said there would be a difference of $\frac{1}{100}$ in an hour.

Q. Then he takes 5·0916 grammes treated as above.

Weight of residue after	2	hours	·5764	or	11·32	per cent.
	8	„	·5727	„	11·25	„
	4	„	·6714	„	11·22	„
	5	„	·5702	„	11·19	„
	6	„	·5698	„	11·19	„

So that you see from this the weight is gradually diminishing down to this point.

Mr. Gully: That is just what this witness has told us.

The Witness: What is the last temperature at which he dries?

Mr. Cottingham: He goes on to say "It appears to me that as much more concordant results are obtained when the solids are dried to constant weight than for three hours only, and that as the fat is much more completely, readily and with a less amount of trouble extracted in an extractor such as Soxhlet's,"—that is a mode of extracting different from the mode you employ—"it would be well to discard the old plan, and accordingly to lower the limit of solids not fat from 9 to 8·5 per cent." What do you say to that, Mr. Estcourt? Do you agree? A. I agree that you may get anything by a change of process. I can invent another process which shall get you still lower solids or raise them higher.

Q. If you have a process that is correct; if this process is a correct one, it results in obtaining from the same milk 8·5 of non-fatty solids instead of 9? A. And it also results in obtaining from the genuine milk 8·5 also.

Q. Then what becomes of your standard of 9 per cent. as the minimum for non-fatty solids in genuine milk ? A. If that method is adopted then the standard would have to be lowered.

Q. Can you support your standard after that ? If where you adopt another method you get by treating the same milk only 8·5 of non-fatty solids instead of 9 per cent. by your method, upon which 9 por cent. you found the 4 per cent. of adulteration, how can you support your standard ? A. I scarcely understand your question, I must confess. I am prepared to say that you will alter the figures by altering the method.

Q. How can you say that your standard of 9 per cent. is an infallible standard ? A Because we do not alter the method ?

Q. We say that you do not use the proper method ? A. Ah, we do not agree with you there.

Q. You have abandoned 9 per cent. once, you had to lower it ? A. No, I have no recollection of any such thing, Do you mean me personally ?

Q. It was 9·3 once ? A. No. 9·3 was used as a basis for calculating the amount of adulteration by some analysts.

Q. So much for Hehner. Do you know Mr. Bernard Dyer ? A. Yes, he is a Member of our Society.

Q. I am now reading from The Analyst of April, 1881. Some Analyses of Milk, by Bernard Dyer, F.C.S., F.I.C. (See Analyst, page 59, vol. vi.) Read before the Society of Public Analysts, on the 16th of March, 1881. Then he goes on and gives the results on the 8th, 9th and 17th of July. He brings out these amounts of solids not fat—9·15, 9·52, 9·36, 8·82, 9·05 and 9·02. There are two of those instances in the same month below your standard.

Mr. Gully : I ask you, Sir, whether we are to have experiments brought forward which nobody knows anything about. I do not know whether Mr. Dyer is here or not. He is certainly not here for us. My friend is putting these figures to the witness and asking whether he agrees with them. They are experiments upon certain cows. How can he agree or disagree. We know nothing as to how the samples were taken or how the results were obtained, and upon cross-examination they are quite worthless. My friend's question is—" Do you agree that such and such cow's milk, when tested, produced such and such results ? "

Mr. Cottingham : I ask him how he supports his minimum standard of 9 per cent., or the standard of this Society in the presence of this statement, and these experiments made and offered to the Society by one of the members.

The Recorder : If I am not wrong, I understand his answer to be this with regard to Mr. Hehner: That a different process of testing will bring out different results ; and if you adopt a different process of testing you must of course adopt a different standard of purity. That I can perfectly well understand.

Mr. Cottingham : I think I have not made my point clear. The standard which he sets forth, which is the 9 per cent. standard, cannot be an infallible standard.

The Recorder : Nobody, as far as I know, ever suggested that it is an infallible standard. The suggestion is merely that it is an accurate standard.

Mr. Cottingham : I think I have not conveyed my point ?

The Recorder : I think I see your point, and I think I see the answer to it.

Mr. Cottingham: This 9 per cent. is arrived at by a certain process. That process according to Mr. Hehner is not the most reliable process, and he has substituted another. When some of the same milk which yields 9 per cent. as a minimum only of non fatty solids is treated in the other way, it lowers the amount of non-fatty solids to 8·05.

The Recorder : I am not expressing an opinion. I am only repeating what I understand this gentleman says. His answer is perfectly sensible and perfectly intelligible even to my mind, and I know nothing of these matters.

Mr. Cottingham : We are upon the question of the standard, and when we find that this standard is impeached and the method by which it is arrived at is impeached also, I want to know from Mr. Estcourt how he can assert that that standard is a reliable one.

The Recorder : He has given his reason, and it appears to me to be a very good one. I am afraid shall expose my ignorance, but I will venture to put in my own words what I understand. You are to boil a certain quantity of the thing three times with ether. That will produce a certain result. That might be a very good standard. If you boil it six times you produce different results.

Mr. Cottingham: Let me put this question to you. Supposing you had adopted the second method and brought out the non-fatty solids 8·5, would you have pronounced the milk to be genuine? A. I have already said that I do not understand the method to be an accurate one, therefore I should not pronounce an opinion founded upon it. A portion of the solids not fat are dissolved out.

The Recorder: If you thought that was a more correct method of analysis you would then bring your standard down from 9 to 8.

Mr. Cottingham: What reason have you for saying that the former method of evaporating for three hours, but still leaving a quantity of moisture not evaporated, and still leaving weight that might be got rid of ———

Mr. Gully: He has not said all that.

The Witness: I do not say that moisture is left at all.

Mr. Cottingham: The method that you adopted was drying for three hours? A. Yes.

Q. You admit now that there would still be a residuum of moisture? A. I have not admitted that.

Q. Do you contend still that after evaporation for three hours you would get down to a constant weight? A. No. I will explain it if you like.

Q. Answer the question.

The Recorder: He is giving you his answer.

The Witness: I say that the milk is decomposed by heating for a long time, when decomposition causes the loss, and not a loss of moisture.

Mr. Cottingham: You are speaking in the presence of many other chemists who will be called by-and-bye. A. Yes, I know that.

Q. You know Dr. Voelcker? A. Yes.

Q. You say that the more recent method is not a reliable one, and that the method you adopted is the proper one? A. It is more reliable I say.

The Recorder: You do not say that the other one is not, but you say your own is the best? A. Yes.

Mr. Cottingham: You admit that the different methods would produce different results? A. Yes, and different standards.

Q. The writer of this paper, Mr. Bernard Dyer, goes on to say this, that on the 4th, 5th, 11th, 12th, and 18th August, he finds that the non-fatty solids amount to 8·71, and with that he concludes his experiments. Then he says—"It will be noticed that B"—that is the Table I have last referred to—"averaged only 8 7 per cent. of solids not fat, and only on one occasion was the limit of the Society actually reached, viz , on Aug. 19th, when the morning milk yielded 9·08 per cent. of solids not fat."

Mr. Gully: I think, Sir, that you should know that this was the milk of separate special cows which were fed and experimented with in different ways to show what the effect upon their milk was. I cannot see what light it throws upon this.

Mr. Cottingham: It shows the variation of the standard—whatever it is worth. (The Analyst, vol. vi., p. 61.)

Q. I want to know what you say to this: "The proportion of fat should be very carefully considered in conjunction with the solids not fat before an opinion as to adulteration is pronounced." You say that the proportion of fat is of no account at all? A. I will answer if you permit me.

Q. I understand you to say that you do not consider the amount of fat any test at all? A. I will give you an explanation which will satisfy you if you like.

Q. I want to get your answer.

The Recorder: He cannot answer categorically Yes or No.

The Witness: If I were analysing a sample of cream which contained 20 or 30 per cent. of fat, I should find the solids not fat very low indeed, probably only 7 per cent.; but the fat there would be very marked in its amount—20 per cent. instead of 2·8 or 2·5—and that amount of fat would be accompanied by a diminution of the amount of solids not fat; both of them cannot exist in the same

100 grains; one is depressed and the other is raised. In that case if I found a large amount of fat I should not condemn the milk; I should know it was a cream.

Mr. Gully: He says he should know that they had given him a specimen of cream and not of milk.

Mr. Cottingham: When you said that you did not weigh the fat, I understood you to say that you did not weigh it because you thought that the presence of an amount of fat was of no value at all in estimating the amount of non-fatty solids? A. I find that the readiest, and best, and most certain method. It is equally as certain as weighing the fat. I deducted the solids not fat from the total solids.

Q. You say that the amount of fat is of no moment at all in the estimation of the non-fatty solids when you test for water. Do you think that the consideration of it is of any moment in testing for adulteration by water? A. No, not unless it exceeds a certain amount.

Q. "The proportion of fat should be very carefully considered in conjunction with the solids not fat before an opinion as to adulteration is pronounced." Can you reconcile your proposition with that statement? A. Yes, I have given you an example. If it were a cream I should consider the fat.

Q. The fat in this case that we have been dealing with now was over the Society's standard was it not? A. It was.

Re-examined by Mr. Gully:—

Q. You have told us the number of hours that you apply heat. In one way or another, first you get rid of the water, then you get rid of the fat? A. Yes.

Q. Applying the process of yours, and the amount of heat that you do apply by that process, ought pure milk to have at least 9 per cent. residuum of solid non-fatty matter? A. It ought.

Q. Applying the process, you mean? A. Yes.

Q. Is it a rule which you have found invariable in your experiments? A. I have.

Q. You say the non-fatty matter may safely be put as 9·3? A. Yes.

Q. If you go on applying heat—excessive heat if need be—to the residuum, will you go on diminishing its weight? A. Yes.

Q. Supposing you were to go on for days applying a red heat it would reduce it to ashes? A. Yes, undoubtedly.

Q. The weight of what was left would be infinitely little? A. Quite so.

Q. Is it a question of judgment at what point it is not worth while going on to apply heat? A. It was found by calculations and experiments that three hours was sufficient, and it was agreed that it should be the method.

Q. The experiment of Mr. Hehner, which my friend read, seems to have shewn that they got only a loss of 6/100 after applying three hours of additional heat to the residuum? A. Yes.

Q. That is 1/100th part of a grain per half hour? A. Yes.

Q. Is it in your opinion worth carrying on that experiment? A. It is not.

Q. Have you got all that is practically valuable for the purpose of testing at the end of the heating in your experiments? A. Yes.

Q. After a certain application of heat, when you have got rid practically of all moisture, is what is diminished by the continued application of heat the solid itself? A. Yes. Then the solid itself begins to decompose.

Q. You say for the purpose of ascertaining really what is the amount of solid residuum, yours is the proper method? A. With the limit that we apply it is the best method.

Q. I suppose that it would be almost impossible to ascertain the precise moment or second of time at which you ought to cease, or at which you would be able to say—Now I have exhausted every particle of moisture, and have not exhausted a single particle of solid? A. That would depend upon the delicacy of the balance simply.

Q. It would be a thing almost impossible for any man to draw? A. Yes.

Q. You have drawn it from your experience as nearly as you can? A. Yes.

Q. If you follow the other experiment and continue the heat, you get a lower figure when you leave off heating? A. Yes.

Q. Does it make any difference as to what is the quality of the milk? A. Granting the same standard it cannot affect it.

Q. If you know what the difference of process is, are those two quite consistent? A. They are.

Q. That you should bring out 9, and somebody else should bring out 8·5? A. Yes, or 8·6, or 8·3.

Q. Then less than 9 under your process you say is a sure sign of adulteration? A. I do.

Q. You know nothing personally of these experiments which have been read to you? A. I do not.

Q. How those samples appearing there were taken you do not know? A. I do not.

Q. On that a good deal depends? A. That is so.

JAMES ALFRED WANKLYN, sworn.—Examined by Mr. Hopkinson :

Q. I think Mr. Wanklyn you are a Member of the Royal College of Surgeons, and you are Public Analyst for Peterborough and Shrewsbury, and other places? A. I am.

Q. Have you analysed many thousands of samples of milk for dairies? A. Yes; during the last thirteen years I have analysed thousands of samples.

Q. Is the method you employed in analysing those substantially the same as that which has been named by Mr. Estcourt to-day? A. Substantially it is the method brought out by myself about the the year 1870, and it is generally adopted by the Public Analysts.

Q. And in this method you for three hours evaporate milk at a temperature of 212° Fah.? A. Yes, I keep milk at a temperature of 212° Fah. for at least three hours. In this way I get the total solids. Then I take the total solids. Then I extract the fat with ether. Then I take the solution in ether, evaporate off the ether and weigh the fat; then I substract the fat from the total solids, and the difference is the solids not fat.

Q. Is your method substantially the same as that which Mr. Estcourt says that he adopted in this case? A. Yes, it is.

The Recorder: It is not quite the same? A. The difference is, that they weigh the solids not fat. As a matter of fact, I have never weighed the solids not fat. Observations have been made by others that the same result is got whether you actually weigh the solids not fat, or get your total solids and subtract the fat from it. I regard the method that I use as the safest. I do not say that it is the best; I say it is the safest.

Q. What should you say was the lowest limit of solids not fat in milk analysed by that method? A. In pure milk it is certainly not below 9. The average is 9·3. My experience is that in real milk the solids not fat never fall so low as 9.

Q. That is when you analyse by that method? A. Certainly.

Q. For that method would you say that 9 was a safe standard? A. That is the limit.

Q. The safe minimum limit? A. 9 is the safe minimum limit; 9·3 is the standard, and 9 is the limit.

Q. You have read the account of the method employed by the Analysts at Somerset House? A. I have.

Q. By this method does the heating go on for a longer time than by your method? A. Very much longer, and the heating is managed in a different way. They not only dry up in the water-bath as I do, but they afterwards dry up in the water-oven.

Q. Is it possible to increase the temperature? A. It is a very bad method indeed. When I arranged the method originally I avoided the water-oven. The water-oven is a source of uncertainty. It may be a pressure vessel.

Q. Increasing the temperature for too long a time would have the effect of decomposing the milk? A. Yes—it would de-hydrate the milk sugar.

Q. Do you find that according to Dr. Bell the milk sugar contains an atom less of water than your own? A. Yes. I should look to get water combined with the milk sugar. Apparently Mr. Bell wants to get anhydrous milk sugar. I get the crystallized milk sugar with a certain amount of water chemically combined with it. Dr. Bell writes the formula anhydrous milk sugar, and apparently works to get it. Keeping strictly at 100° and drying in the way I do, you get the hydrated milk sugar; and if you raise the temperature you get off the water which is chemically combined.

Q. You would decompose the residue? A. You would decompose the hydrated milk sugar and get anhydrous milk sugar.

Q. Would not the effect of that be if you attempted to set up a milk standard, on the Somerset House process, that you must have a lower standard than 9? A. You would have to have a lower standard. You would decompose the hydrated milk sugar and get anhydrous milk sugar.

Q. I think they also state that after the evaporation the residue is moistered with water. What would be the effect of moistening with water before the ether was put in? A. You risk dissolving away a little milk sugar along with the fat.

Q. That would be another possible cause of reduction of solids not fat? A. You would get them down.

Q. The solids not fat would be slightly decreased? A. The fat would be increased. 9 is the limit. 9·3 is the standard. I always calculate by 9·3. For instance, in this case I should say 7 or 8 per cent. of water. Strictly it should be "Most probably 7 or 8 per cent. of water, but 4 certainly"—"at least 4, but most probably 7 or 8.

Q. When the standard is 9, you think that the minimum amount of adulteration here is 4? A. Yes, the real adulteration in that case I should believe to be 7 or 8.

Mr. Gully: If the milk had been 9·3 or 9·4 in its pure state? A. Milk does contain 9·3 or 9·4 of solids not fat according to my method; but as a matter of fact I do not believe that milk ever goes down to 9 and the little difference of ·3 is allowed to cover error in manipulation and possible variation.

Q. Then of course you would say it was perfectly absurd to compare an analysis made by your method with a standard made by the Somerset House method? A. Certainly.

Q. In that case you would pass milk that was very much adulterated, I suppose? A. If you used my process and applied the Somerset House standard you would pass watered milk undoubtedly.

Q. With regard to decomposed milk. You have analysed various decomposed milks? A. I have.

Q. Is not it a usual result of decomposition, to some extent diminish the amount of solids not fat? A. It is, but the diminution is very irregular indeed.

The Recorder: Under what process? A. Keeping. If you keep milk for a length of time and then examine it, you may find the same result as at first, or you may find a loss of solids not fat.

Mr. Hopkinson: You find that usually the result of decomposition is to diminish the solids? A. Usually, but it is not invariably so.

Q. Have you found cases in which after keeping for a length of time the milk contains exactly the same amount of solids not fat as before keeping? A. I have, or practically the same. It may make a very considerable difference, or it may make next to no difference, or only a difference within the limits of experimental error.

Q. Can you then from the result of an analysis of decomposed milk say with certainty what that milk consisted of when fresh? A. Not accurately. In very gross cases, of course, you could tell. In a case where, for instance, it was half water, the ash would shew that. In a very gross case it would shew it; but in cases which are not gross the ash, which you rely upon when the milk is decomposed, would shew nothing.

Q. Could you detect 5 per cent. of added water? A. Oh, no; you could not detect 20 per cent. with certainty by the ash.

Q. Do you think any trustworthy results can be arrived at by a process of adding so much per week in respect to decomposition? A. Oh, no; I am sure it cannot.

The Recorder: I can quite understand that question and answer, but for my own information I should like to know whether in the calculations made by the Somerset House Analysts any rule has been laid down as to length of time.

Mr. Hopkinson: Perhaps you will allow me to read the cross-examination which took place on the previous occasion.

Mr. Cottingham: No.

The Recorder: Is that the view you take of the course adopted by the Government Analysts?

Mr. Hopkinson: The view we take of the course adopted by the Government Analysts is this. By the actual analysis they found in one case 8·2 per cent. of solids not fat, and in the other case a rather smaller quantity. After having found that as a matter of fact they say this milk is a little decomposed, we shall add on so much per day or per week for the loss by decomposition by rule of thumb.

Mr. Cottingham: Not by rule of thumb.

Mr. Hopkinson: That is what we say.

Mr. Gully: What we say is that they have added $\frac{38}{100}$ths on that, and they have done that by this process: They have said the milk loses ·24 per cent. in the first seven days. Then in the next 14 days it loses another ·10, and ·01 for every following day, and by that sort of calculation they say they arrive at a figure of ·38 or ·40, which should be added to or allowed,

The Recorder: This witness says that is fallacious.

Mr. Gully: Fallacious altogether. It may possibly be right on one occasion, or nothing may be the right amount to allow, or on another occasion twice as much as they have calculated should be allowed.

Mr. Cottingham: Where my friend Mr. Gully got what he has just stated to the Court I do not know; it never has been in evidence at all.

The Recorder: I only want to know what the argument is on the case for the respondents. I want to be fully informed of what their case is. I am not anticipating what the case of the other side may be.

Mr. Cottingham: Their case is that their standard is right and their method is right. My case is that they are both wrong.

Mr. Hopkinson: Assuming, with regard to any given sample of milk, that so much a day or so much a week was added for decomposition, would you say that the result might be wholly fallacious? A. Certainly. I have known old and apparently decomposed milk give the same figures as at first, or very nearly the same figures.

Q. Even although the milk was apparently decomposed? A. Yes. I have been surprised at the slight alteration that accompanied what appeared to be decomposition. I think it is quite hopeless to attempt any correction of this kind.

Q. If you had made an addition of so much per week according to any average standard for decomposition, you might have passed milk that was watered as much as 7 or 8 or 10 per cent? A. Oh, yes.

Q. With regard to ash. Is ash a reliable test with regard to small amounts of adulteration with water? A. No.

Q. It is a test when you get to very gross cases? A. To show 50 per cent., but it will hardly show 20 per cent.

Q. When you are analysing samples of milk either to establish a standard or otherwise, do you yourself see the milk taken? A. I take a very great variety of precautions of one kind or another. The samples that I have obtained from dairies were obtained many years ago, and I took what I considered efficient precautions.

Cross-examined by Mr. Cottingham:—

Q. In making your analysis you usually weigh the fat? A. I do, and subtract the weight from the total solids.

Mr. Cottingham: You weigh the total solids first? A. Yes.

Q. Then you extract the fat and weigh it. Then you deduct the fat, and that gives the weight of the solids not fat? A. Yes.

Q. Do the different constituents of milk vary, or are they in genuine milk supposed to be constant? A. The fat in real milk varies enormously. The solids not fat rise from 9·3 to sometimes 10½, but they never go down.

Q. They never go down below what? A. I believe they really never go down below 9·3.

Q. In arriving at your standard of 9 per cent., is that founded upon a number of cases and taking the mean—the average? A. 9·3 is the mean, and is obtained from an immense quantity of work—my work; and it is all the work that I could lay my hands upon.

Q. In point of fact that 9 3 is the mean or average of a great number of cases? A. The mean probably of many thousand tons of milk.

Q. May we take it that some of the instances from which this average was taken must have been below—showing a lesser quantity than 9·3. A. Very slightly below.

Q. But still there were instances? A. There must have been.

The Recorder: I am not intimate with these matters, but same must have been below and some above.

The Witness: Very slightly below.

Mr. Cottingham: Milk may be perfectly genuine, yet even by your method yielding less than 9·3. A. Yielding 9 3 or very slightly below 9·3. To allow for that we take the limit of 9.

Q. In your analyses do you use ether or benzoline? A. I always extract with ether.

Q. Your process is that which is adopted by the Society of Public Analysts? A. It is the process almost universally adopted.

Q. Do you mean to say that you have never found in any sample of genuine milk, non-fatty solids to fall below 9 per cent? A. I have done so many analyses that I cannot answer Yes; but this I can say, that I know of no such case where I should attribute the difference to anything but experimental error.

Q. I want to know whether you have found in your own analyses, or whether you will say you have never found in your own analyses, a single instance of genuine milk produce less than 9 per cent. of non-fatty solids? A. Certainly I have never found that.

Q. How has it come down from your standard of 9·3 to the minimum of 9? A. It has not come down to that as a minimum, the standard is 9·3—that is the true figure, but we admit a limit of 9. The limit of 9 is really invented by the Society of Public Analysts. 9·3 is the standard used by me, and 9 was accepted by me as the limit.

Q. Except that it is adopted by this body, called the Public Analysts' Society, is it adopted by any other society in England? A. There is no other society in England that the question would come before, as far as I know.

Q. Has it ever been to your knowledge officially adopted by Somerset House? A. I have no knowledge of what they do at Somerset House. I have never been in the laboratory.

Q. It is only adopted by this body of Public Analysts? That does really all the work that there is.

Q. You are not a Member of the Society of Public Analysts? A. I left it some years ago. I was Vice-President at one time.

Re-examined by Mr. Gully:

Q. I do not know whether you know that this same minimum has been actually adopted in the United States by law? A. I know that my book has had a sale in the States. I heard that it was reprinted in the States.

The Recorder: I want to ask you a question or two. What are these non-fatty substances? A. They consist of caseine, plus milk sugar, plus mineral matter—ash.

Q. Do the proportions differ according to whether the animals are fed upon produce from different soils? A. The relative proportions of milk sugar and caseine vary much—that is to say, one milk will contain more milk sugar than another, and one milk will contain more caseine than another. It curiously happens that when the caseine is low the milk sugar is high, and when the milk sugar is high the caseine is low. The solids not fat are more constant than either ash, milk sugar, or caseine.

Q Does the mineral vary much? A. The mode of determining the mineral matter as we do it is in the percentage accuracy not very accurate. There are only ·7 per cent. of mineral matters in milk.

Q, What is the reason why milk from one soil will produce better cheese than another? A. The amount of fat is very variable in milk.

Q. Not the amount of caseine? A. No, the great variable is the fat. Cheese consists of fat to a great extent. It is a popular error that it is caseine alone. The curd is fat and caseine together, and it is the curd that makes the cheese.

Mr. CHAS. ESTCOURT RECALLED.—Further cross-examined by Mr. Cottingham:

Q. As to these samples that you have taken from the cows, since this case commenced, in Cheshire and elsewhere. How were those cows fed—were they highly fed cows? A. They were out at grass, and some were stall-fed upon brewers' grains.

Q. Some of them were stall-fed. What proportion of the samples were taken from the stall fed cows? A. I do not know that the grass-fed cows would be. I presume they would be fairly fed.

Q. You saw the cows? A. Yes.

Q. Were they all beasts in high condition? A. I should not say so, they were fair average cows I suppose. In some cases they might be better cows than in others.

Q. That is really not an answer. You saw some of the samples taken yourself? A. A large number of them.

Q. As to the samples that you saw taken yourself, you can speak to the condition of the cows from which the samples were taken in your presence. Were they all well-conditioned and well-fed cows? A. They were all in fair condition.

The Recorder: Is it your experience that highly-fed cattle produce better milk than others? A. It is not.

Mr. OSWALD WILKINSON, SWORN.—Examined by Mr. Gully:

Q. Are you a chemist by profession in Arcade Chambers, Market Street, and Public Analyst for Stockport; were Lecturer on Chemistry at Owen's College for two years? A. Yes.

Q. Did Mr. Wardle, the appellant, bring you a sample of this milk? A. He brought me a sample which was numbered 204, which I presumed to be the same.

Q. When did he bring it? A. On the 27th of April.

Q. Was it at that time in a state fit for analysing? A. Certainly.

Q. There was no decomposition? A. Not that would affect the analysis. It was slightly acid and somewhat curdled.

Q. Did you analyse it by the same process generally that Mr. Estcourt described? A. A similar process, but different inasmuch as I weighed my fat.

Q. A similar process except that you weighed the fat? A. I weighed the total solids and also the fat, but not the solids not fat.

Q. The same process, but you weighed the fat in addition? A. Identical, with that exception.

The Recorder: Mr. Wanklyn and this gentleman weighed the fat; the other gentleman weighed the solids.

Mr. Gully: He weighed it by the same process, but with the added precaution of weighing the fat.

The Witness: That is so. I did not weigh the solids not fat. I obtained those by difference. I weighed the total solids, including solids not fat.

Q. Did you ascertain by the process that has been described what was the quantity of solids not fat and of fat? A. Yes, I got the solids not fat by difference. There were solids not fat, 8·66 per cent.; fat, 2·86, obtained by weight.

Q. Does that in your opinion indicate adulteration by water—that is the presence of water not naturally in the milk? A. Certainly.

Q. To what extent? A. To the extent of about 4 per cent. I have 3·8 in my report because I certified the exact percentage I got from my calculation, but I should say in round numbers 4 per cent. if not more.

Q. You were doing that as you say at Mr. Wardle's request. Had you any communication whatever with Mr. Estcourt in the matter till long afterwards? A. I could not say how long, but a considerable time.

Q. Is it the process you would always use for the purpose of seeing whether milk had been adulterated by water? A. Yes.

Q. As far as your experience goes is it the safest, and is it the process generally used? A. Yes, by Public Analysts.

Q. Do you think that a test of milk 21 days' old can be fairly compared with a test of the same milk taken while it was fresh? A. I do not think so. I think the results obtained would simply be approximate.

Q. Would you place any reliance upon such a test if you found that you had before you two or three tests taken while the milk was fresh? A. No; I should give the fresh ones the preference decidedly.

Cross-examined by Mr, Cottingham:

Q. You got this sample on the 27th April—that would be five days after Mr. Estcourt's sample? A. I received mine on the 27th at 1.30 p.m., that would be three days.

Q. Was the milk at all sour? A. It was slightly; it was decidedly acid.

Q. Was there incipient decomposition? A. No; I do not think so.

Q. Did you treat the milk first with any alkali? A. None whatever.

Q. Do you consider the milk in that sour state is as favourable for analysis without alkaline treatment as when the milk is fresh? A. I think there would be no appreciable difference in the result of the analysis. I say that it is not less than 3·8, possibly more.

Q. You cannot arrive at this deduction from the amount of non-fatty solids. That does not give you the absolute determinate quantity of adulteration; it is merely approximate to it.

The Recorder: He does not say that at all, and it is no good trying to make him say it. What he does say is that the minimum is 3·8.

The Witness: It is 3·8, and I hold to that statement.

Q. As there is a maximum and minimum, the quantity of adulteration is not fixed absolutely in any of these cases? A. That depends upon what standard you take. The milk may have been very rich milk, and then it is much more adulterated.

Mr. Cottingham: Was not the fat in this milk rather above the standard? A. No, rather below—2·86 per cent.

Q. Do you know the standard of the Public Analysts' Society for fat? A. 2·5 is the lowest minimum of the Public Analysts' Society; but I believe in genuine milk it is higher.

Q. It is quite clear from this analysis of yours that the total solids were rather above the Society's standard?

The Recorder: It is not a question of standard. You keep altering the term. He gives you a limit, and he gives you a standard, and you keep calling the limit the standard.

Mr. Cottingham: Your total solids were 11·52 per cent? A. Yes, and the fat 2·86. I say that the minimum limit of the Public Analysts' Society is 2·5, but that is very low; it is taken as the lowest limit. I should say that 3 is low.

Mr. OTTO HEHNER, sworn.—Examined by Mr. Hopkinson:

Q. I think you are a Fellow of the Chemical Society, and you are Public Analyst for South Derbyshire? Yes.

Q. Did you analyse a sample of milk sent to you by the defendant in the month of April? A. I should like to ask the Recorder first whether I am obliged to give evidence on the subject. I got this sample from Mr. Wardle, and I consider, until I am obliged to give this evidence, that it is the property of Mr. Wardle. I am subpœnaed by the borough to give property which does not belong to me.

The Recorder: I do not think the law allows any privilege in this case.

Mr. Cottingham: On behalf of Mr. Wardle we do not make any objection.

The Recorder: Yor are quite right not to wish to give it, because it is to some extent confidential, but at the same time there is no privilege known to the law in your case.

The Witness: I got a sample of milk which I was told came from Mr. Wardle on the 28th April of this year, and analysed it on that day; the milk was in such a condition as to be capable of being properly analysed.

Q. What was the number of the sample. Was there a number on it? A. The sample was labelled "City of Manchester, Food and Drugs' Act, 1875: Sample No. 203." I declared the sample to be adulterated to the extent of about ten per cent.; but I explained in my certificate that the sample was sour when received, hence it is impossible to ascertain very accurately the extent of added water. Decomposition had not advanced sufficiently to interfere very seriously with the result of the analysis.

Q. What was the amount of solids not fat found by you? A. 8·29, and fat 2·71.

The Recorder: Surely I have made a mistake. It cannot be 8·29. A. Yes—solids not fat. Then fat 2·71, total 11·00.

Mr. Hopkinson: What method did you employ? A. Substantially that one which has been several times spoken of by other witnesses. I weighed the solids not fat. I should say that the method is not exactly that which has been used, but it is substantially the same. I have had a good deal of experience in analysis of milk.

Q. What is your view with regard to the possibility of arriving at the original composition of milk from an analysis of decomposed milk? A. You can never arrive with the same certainty at any result, and when a certain point has been reached in decomposition it is an impossibility.

Q. I suppose the rate of decomposition depends upon a very large number of circumstances. A. Very many circumstances.

Q. Weather and heating? A. Yes; temperature, time, air, bottling, and a great many circumstances.

Mr. Cottingham: Decomposition depends upon what? A. The temperature, the season of the year, the amount of water, the manner in which it is filled and bottled, whether the bottle is filled entirely or only half full, and many little circumstances of that kind. I would undertake myself to fill from the same sample two bottles, and the one bottle shall decompose at the rate of 2 per cent. per week, and the other shall not decompose at all; that is to say I can keep a sample a week at will, or can cause it to decompose very rapidly according to circumstances.

Mr. Hopkinson: Do you think it is possible to make a calculation according to the length of time the milk is kept and add that to the result of your analysis as a mode of arriving at the composition of the milk? A. You cannot.

Q. Supposing you employed the process described by Mr. Wanklyn, what should you say was the minimum standard for solids not fat? A. 9 per cent. is perfectly fair.

Mr. Hopkinson: Is the Wanklyn process, or one that is substantially the same, one that is regularly adopted by Public Analysts in England? A. Yes, generally; and the Society of Public Analysts includes pretty well every analyst in England; and other analysts have scarcely ever milk to analyse.

Q. What is your opinion with regard to ash as a mode of arriving at the amount of adulteration by water. A. You cannot use it for ascertaining the exact amount; but it has some value in connection with other estimation. If the ash is very low, lower than it could possibly occur in natural milk it would help in forming an opinion.

Q. Milk sugar is soluble in water? A. Yes.

Q. Is the effect of prolonged heating to some extent to alter the composition of milk sugar? A. It does. If you take we will say a pound of milk sugar pure and dry, and heat for some length of time, it will lose in weight about 7 or 8 per cent. It loses what is called water of crystallization.

Q. Accordingly if you make a milk standard or a minimum standard of milk with the method described in Dr. Bell's book, you would arrive at quite a different result from that which you would get by Wanklyn's process? A. You would naturally arrive at a lower result.

Cross-examined by Mr. Cottingham:

Q. You will not say that that lower result is not an accurate result? A. It is not a question of accurate result; it is a question of getting the result under certain conditions.

Q. Your standard of 9 per cent. is obtained under certain conditions? A. And is accurate for those conditions.

Q. This milk you say was sour. Did you estimate the amount of acid? A. I did.

Q. What was the amount of acid? A. ·51 per cent. of lactic acid which had been generated by decomposition.

Mr. Cottingham: You are of opinion that this standard of 9 per cent. is rather too high? A. Not at all.

Q. Allow me to draw your attention to your own paper. "It appears to me that as much more concordant results are obtained when the solids are dried to constant weight than for three hours only, and that as the fat is much more completely, readily, and with a less amount of trouble extracted in an extractor such as Soxhlet's, it would be well to discard the old plan, and accordingly to lower the limit of solids not fat from 9 to 8·5 per cent." A. It was my opinion then and is now that it would be better to alter the process and to alter the limit; but the limit is good for the process, and if you alter the process you must alter the limit.

Q. Do you say that the Wanklyn process or that the Somerset House process is the best? A. I give no opinion upon the Somerset House process.

The Recorder: They are both good processes? A. I do not think so. I think one is a bad process.

Mr. Gully: Tell us which is bad by all means.

Mr. Cottingham: You think that the Somerset House or Government process —— A. It is not a Government process. I am a Government official just as much as the Somerset House people are. It is not a Government process at all.

Q. It is the process adopted by those who analyse for the Government? A. No; we analyse for the Government also. It is the process adopted by those gentlemen.

Q. What do you mean by saying "It would be well to discard the old plan." What was the old plan you allude to? A. The Wanklyn process. The plan that is in use is the old plan.

Q. That is the Wanklyn plan? A. Yes.

Q. You have advocated discarding Wanklyn's plan and you suggested the lowering of the solids not milk from 9 to 8·5? A. In connection with the process.

The Recorder: What is the alteration of process? Give it to us shortly. A. Without putting my opinion against Mr. Wanklyn's, which is more valuable than mine, I would prefer to dry till the solids cease to lose weight—to dehydrate the milk sugar, and extract the fat in a manner which I consider more convenient than Mr. Wanklyn's manner. It is only a difference in manipulation.

Mr. Cottingham: You prefer not to leave off drying until you get to a constant weight? A. I think it would be better.

Q. In fact that was the result you came to by this long table of experiments we have here? A. Yes.

Re-examined by Mr. Gully:

Q. What is it that you object to in Dr. Bell's process? A. I object to the manner in which the fat is extracted. Mr. Bell does not only extract fat, but he extracts other things which he adds on naturally to the fat, or rather the fat appears larger by his process than it is, and in consequence the solids not fat appear smaller than they are actually.

Q. In his analysis by his process the fat appears larger than it is really at the expense of the solids not fat? A. Yes, that is so.

Q. That has nothing to do with the mere applying of the heat, has it? A. No, that is in the extraction of the fat.

Q. By what means? A. By means of ether. It is well known that pure ether will only dissolve the fat, but as soon as ether contains water, as it must do in Bell's process, the sugar of milk is dissolved in addition, and I have no doubt also mineral substances.

Q. In his process when he comes to dissolve the fat, he puts water with the ether? A. Yes.

Q. You say that the effect is not merely to take away the fat, but something else? A. Yes. Some of the solids which go away with the fat is weighed with the fat. That renders it uncertain for the purpose of testing the solids not fat. These are the important things to test for in testing for adulteration by water.

Q. Whether you dry by the process which you recommend (which I understand is not Bell's process, but a process of heating longer and more), or whether you apply the process which you did apply in this case are you equally satisfied that this milk which you tested was adulterated by water? A. Entirely. I should say that I did not know anything about the statement of the Public Analyst when I made my report. It is a perfectly independent report. I was inclined to be in favour of my client if anything.

Dr. A. DUPRÉ, F.R.S., SWORN.—Examined by Mr. Gully:—

Q. Are you Professor of Chemistry at Westminster Hospital, and employed by the Home Office, and by the Medical Department of the Local Government Board, and Public Analyst for the Westminster District Board of Works? A. I am.

Q. Wherever you have reported adulteration there has been a conviction upon it? A. In every case.

Q. I want to know what process you have followed in those cases, and what do you consider the best process. A. I adopted substantially the process described, but I also weighed the solids not fat. I think it gives easier and more accurate results.

Q. Do you consider that applying that process, milk below 9 is adulterated? A. I have no doubt about it in my own mind.

Q. Is that the principle you always act upon as a Public Analyst? A. I always make my calculation upon 9·3, but I would not report against a milk if it contained 9.

Q. But if less than 9? A. If less than 9 I always report against it.

Q. Do you consider that an analysis taken of milk when it is three weeks old can be safely compared with an analysis of the same milk when it was fresh? I would not pay any attention to the one three weeks old. I think it is perfectly useless.

Q. Do you find in fact, in your experience, that where milk is sent out less than 9 per cent. of solids that it can be brought up to over 9 again? A. I do not know, but I notice this: whenever my inspectors have not been round for a few months the milk in my district sinks down to 9 and a little below frequently; but after they have once been round, and go round again, the next week the milk invariably goes up to 9·3 and 9·4. It has never yet been otherwise.

Q. From time to time when you or your inspectors are active, the milk can always be brought up to 9·3? A. Yes. If they go round on week days it is 9·3. If they occasionally go round on Sundays it is below 9.

Q. You know Dr. Bell's work? A. Yes, I do.

Q. I daresay you have read the tables upon which he bases his views in that book? A. I have.

Q. Are those results which you say are from properly taken samples accurate? A. I do not think so. I go further. I say that these tables demonstrate that Mr. Bell's process is not accurate; it is demonstrated to be inaccurate by the tables he puts forward; because the most easily taken figure, and the one which is generally most accurate—the specific gravity of milk, depends especially upon two factors—upon the solids not fat and upon the fat. The solids not fat raise it, and the fat depresses it; but if you have the total solids and the fat you can always calculate—or even if you have the specific gravity and the total solids you can always calculate the solids not fat from the specific gravity with a considerable degree of accuracy. If you look over these tables they are most extraordinary. There is *no relation* whatever between the *fat* and *the solids not fat*, and the specific gravity. You sometimes get as much as 1036 sp. gr., and instead of giving you milk with more solids it actually gives you milk with less.

Q. Does that confirm you in the opinion expressed by the last witness, that by his process he deducts from the non-fatty matter and actually adds it to the fat? A. Yes, he takes more fat than is really present, and sometimes he adds apparently very much to the fat, and sometimes he adds a little to the fat.

Q. And you say that that is shewn upon these tables to a great extent? A. To a very considerable extent.

Q. And that could not be if the process were accurate? A. It could not be.

Cross-examined by Mr. Cottingham:

Q. Have you recommended prosecutions in a great number of cases? A. I never recommend prosecutions. I only give my certificate. I have nothing to do with prosecutions. I only know when a prosecution has taken place.

Q. How many prosecutions can you call to mind in which you have given a certificate of 4 per cent. added water? A. As it happens I have not amongst the 320 samples of milk a single one which is 4 per cent.; I have one or two 5 per cent. They are generally either above 9 or very much below 9. I give them as adulterated to the extent of 5 or 10 per cent. The great majority have more than 10 per cent.

Re-examined by Mr. Gully:—

Q. In this case the fatty solids are low? A. Yes.

Q. Were there prosecutions in those cases you spoke of where the adulteration was 5 per cent.? A. Yes, and no protest generally: there was some explanation why it must be so; either that the milk had been left standing in the rain, or that the milk had ran short and they were obliged to buy some, or something like that—clearly indicating to my mind a knowledge that it was adulterated.

Q. Do you put it in round figures or decimals? A. Always in round figures—about so much. I calculate from the 9·3. I would say that this milk was adulterated to the extent of 7 or 8 per cent. of water

Mr. GEORGE WILLIAM WIGNER, SWORN.—Examined by Mr. Hopkinson:

Q. I think, Mr. Wigner, you reside in London, and you are President of the Society of Public Analysts; and have had great experience in the analysis of milk? A. I have.

Q. What should you say was the fair minimum standard, if you employed the process that has been described by Mr. Wanklyn? A. I fully agree with 9 per cent. as the limit, but I invariably calculate upon 9·3 when adulteration is once found.

Q. Do you think that anything lower than 9 would be too low? A. Anything lower than 9 would allow watered milk to pass; in fact 9 frequently allows watered milk to pass.

Q. Then taking the figures given by Mr. Estcourt as accurate, would you in your judgment say that this milk was watered to the extent of at least 4 per cent? A. If the sample had been brought by one of my inspectors I should have certified to an adulteration of 7 per cent.

Q. What is your view with regard to the possibility of arriving at an accurate analysis of decomposed milk? A. It is almost useless when the decomposition has got to such a stage that there is a cheesy smell in the milk; and it is very uncertain, even when it has not got so far as that.

Q. As regards any specific sample of milk, can you say that the original composition of milk could be arrived at by making an addition to the analysis of decomposed milk? A. No, it could not.

Q. Would an addition that might be right in one case be totally misleading in another? A. The addition would have to be regulated by so many different circumstances that one specific correction cannot be applied. A most material thing in altering the the rate of decomposition is that watered milk decomposes at a very different rate to genuine milk.

The Recorder: Faster? A. Generally faster.

Mr. Hopkinson: From analysing milk that was decomposed and three or four weeks old, could you possibly arrive at the composition of the decomposed milk? A. You might by accident come somewhat near the truth, but there would be no certainty.

A. You would not venture to give a certificate that milk had not been watered after analysing it when it was three or four weeks old? A. Certainly not.

Q. Supposing you were analysing decomposed milk three or four weeks old, would you be incapable of pronouncing an opinion as to its original composition? A. In some cases I might be able to say that it had been watered, but I should never be able to say that it had not been watered. If it had been watered to the extent of 50 per cent. I could tell that.

Q. Could you, after such a lapse of time, detect a small amount of water? A. No, certainly not.

Q. Accordingly you would not certify under such circumstances that milk had been watered or not, unless the amount of added water were very large indeed? A. If the amount of water was very large it would be possible to find it.

Q. Have you looked at the tables given in Dr. James Bell's book? A. I have.

Q. I think in the first column he gives the specific gravity, then he gives the amount of solids not fat, and then the amount of solids which are fat. As Dr. Dupré has told us, the specific gravity of milk is higher if the solids not fat are large, and lower if the solids which are fat are large? A. Yes.

Q. The specific gravity of milk varies according to the amount of solids which are not fat, and inversely as the solids which are fat? A. Yes.

Q. Looking at the figures given for the specific gravity of milk in those tables, and the amount of solids which are fat and which are not fat, are the results possible? A. They are quite impossible; they are quite incomparable with anything ever done in analysis of milk before. The tables are such as could not have been obtained by any accurate process from any samples of milk.

Q. Look at Table V. The first column gives the specific gravity, then you have the solids not fat, and then you have the solids fat. Take two of those and compare them. Can you find cases in which the specific gravity differs largely where the fat is constant, and yet where the solids not fat are not as they would be, judged from the specific gravity? A. The figures in the different columns do not tally one with another.

Mr. Cottingham: Which figures do not tally? A. About half way down on page 20, there is a figure of 1028·35 in the specific gravity column, and as against it there is 10 42 of non-fatty solids and 5·66 of fatty solids.

Mr. Hopkinson: That is a low specific gravity is not it, and a very high amount of non-fatty solids? A. A very high amount; a perfectly abnormal amount.

Q. Is the high quantity of fat enough to account for the discrepancy? A. No. Then about the fifth or sixth from the bottom is another one. The specific gravity is 1035·56.

Q. That is a very high specific gravity? A. A very high specific gravity. Then there is 9·71 of non-fatty solids and 4·13 fat.

Q. Are those two cases possible to be both true? A. They are not at all comparable.

The Recorder: I have followed everything up to this, but I do not follow this.

Mr. Hopkinson: Very shortly it is this. The specific gravity of milk is large if the non-fatty solids are large. The non-fatty solids are heavier than water, so that if the amount of non-fatty solids is large the specific gravity is large too. That being so, one would expect where the specific gravity is 1028·35, which is a low specific gravity, that the non-fatty solids would be very low also; instead of that we find them in this example very high On the other hand, 1035·56 is a high specific gravity for milk; yet we find in that case where the specific gravity is high, that there is actually a lower amount of non-fatty solids.

The Recorder: Now I understand.

The Witness: It is physically impossible that the analysis has been properly conducted, unless the difference in the fat was sufficient to account for it.

Mr. Hopkinson: Mr. Wigner has told us that it is impossible for the difference in the fat, which is small, to account for the discrepancy. The fatty solids, if high, rather reduce the specific gravity, so that what we say is, that on the face of this table, as Dr. Duprè has said, and as this gentleman says, it is quite impossible that these results, in this standard, here arrived at, can be accurate. On the face of it they are demonstrably wrong.

Q. Have you taken other samples which shew the same thing? A. I have taken out several other examples of the same kind. In fact the next line above the first I mentioned will illustrate it again. There you have 1033·60 specific gravity, and there are others which shew the same.

Cross-examined by Mr. Cottingham:

Q. About the question of specific gravity. You say the specific gravity depends upon the amount of non-fatty solids? A. And fatty solids.

Q. The non-fatty solids are composed of sugar of milk, caseine and mineral ash? A. Yes.

Q. May not those constituents differ amongst themselves in the same milk? A. They do to some extent. When the amount of caseine increases, the amount of milk sugar generally decreases.

Q. That surely would influence the specific gravity of the mixture? A. It would influence it but very slightly.

Q. You have been criticising these analyses of Dr. Bell. Have you made any experiments yourself to justify what you have been saying? A. I have made more than 30 analyses during the last fortnight according to Dr. Bell's process. The process you must know was never disclosed till the last hearing of this case. It has been a secret process during the last eight years: it has never been known to anybody.

Q. What are the experiments you have made on which you found your attack on Dr. Bell's method? A. I have taken 30 recent samples of milk which I have analysed in my laboratory by the Wanklyn process, and I have analysed those samples side by side by Bell's process.

Q. Have you made allowance in your experiments for the variation in the non-fatty solids amongst themselves? A. There is no allowance needed, because I have taken the same milk side by side for the two processes.

Q. Have you, in the course of your experience, never found genuine milk which had less than 9 per cent. of non-fatty solids? A. I have seen genuine milk from a single diseased cow below 9 per cent., but I have never seen it from a herd of cows.

Q. Have you never seen it in any case other than that one case? A. I have seen it in other cases with foot and mouth disease.

Q. Have you never, except in case of cows having foot and mouth disease, found genuine milk with less than 9 per cent. of non-fatty solids? A. I have not.

Q. I am going to quote now from Dr. Bell's book, page 27. What do you say to this statement of Mr. Dyer. You know Mr. Dyer? A. I do, very well.

Q. What do you say to this remark on page 27 (ANALYST, vol. vi.)? I say that Mr. Dyer did not see the cows milked.

Q. "The foregoing analyses illustrate what has frequently been pointed out before—that stall-fed cows give richer milk than cows at grass, even when supplied with additional food in the shape of oil cake, and they give good examples of the great variations to which the milk, even of individual cows, is subject." Do you admit that that was stated? A. Yes.

Mr. Cottingham: What do you say to this? "In a third instance, Dr. P. Vieth stated that in a herd of 120 cows in Baden, in Germany, the average yield of non-fatty solids, for the years 1879-80, fell in most cases between 8·5 and 9·0 per cent., and that they never rose above 9·0, but fell occasionally below 8·5 per cent. In the case of individual cows the non-fatty solids varied, as a rule, from 8 to 9 per cent., but they sometimes fell below 8·0, and in a few instances they rose above 9·0 per cent. At Kiel, the average of the milk of 10 cows was as follows:—

"In 1878 .... Non-fatty Solids, 8·73 per cent.
1879 .... " " 8·71 per cent.
1881 .... " " 8·53 per cent."

Have you any reason for impeaching the authenticity of that statement?

A. The analyses which are spoken of there are not made according to the Wanklyn process. The fat has been extracted in a totally different way.

Q. What process were those made by? A. They were extracted in a Soxhlet apparatus. They were, in addition, mixed with sea-sand, and pulverized in a mortar before the fat was taken out.

Q. What would be the effect of the sand upon the non-fatty solids—would it increase or diminish the amount? A. When milk is dried down by the Wanklyn process with a given sample, you get 9 per cent. of non-fatty solids; and by the other method, 100 grains of milk is put into a platinum basin to be dried down, and you put in 500 grains of sea-sand, and carry out the analysis in that way the solids would come out 8·6 and about 2·9 of fat.

Q. I should like to know what difference in the ultimate result the use of sea-sand makes? A. That is exactly what I have been trying to say to you, and you would not let me. Instead of getting 9 per cent. of solids not fat, you get 8·5, or 8·6.

The Recorder: Why should the process you have just described produce a less amount of non-fatty solids than the process which is generally used now? A. Because the sand process would insure the extraction of the very last trace of the fat, and in fact a little of the milk sugar with the fat, and that would be counted as being all fat; whereas, by the process carried out by Mr. Wanklyn, it is always admitted that we leave a small portion of fat not extracted from the milk. In that same paper Dr. Vieth says: "I am fully aware that those figures just communicated to you cannot be compared directly with figures obtained by Public Analysts, as our methods of analysing differ." I am reading from the same paper.

Mr. Cottingham: Then the use of the sand is for the purpose of drying? A. It is used really for the purpose of making the extraction of the fat more complete.

Q. The use of the sand is simply to assist in the extraction of the fat? A. Yes.

Q. How is the milk sugar brought out by the sand? A. It is dissolved out by the ether.

Q. That is the way you explain how the use of the sand interferes with, or alters the weight of, the non-fatty solids? A. Yes.

Q. By which of the two methods—Wanklyn's method, or the other—do you extract the greatest quantity of fat? A. The sand method.

Q. In the method that you have been speaking of do you use ether? A. Yes.

Q. That is for the extraction of the fat? A. Yes. The method will be perfectly familiar to all the gentlemen behind you. The sand is put in the Soxhlet apparatus and boiled for several hours.

Q. Now here is another quotation from The Analyst of April, 1882.—"At Proskau, in 1879, the average of non-fatty solids was 8·42 per cent."? A. That is a portion of the same paper.

Q. Yes. "Dr. P. Vieth further stated, as the result of 18 months' experience in England, that 9·0 per cent. as a standard for non-fatty solids is too high? A. I find that in Dr. Bell's book, and I think it is a most unfair quotation. It is on page 27, and it is a quotation taken out without taking the context with it, where he says: "I am fully aware that those figures just communicated to you cannot be compared directly with figures obtained by Public Analysts, as the methods of analysing differ."

Mr. Sutton: It is the truth, but not the whole truth.

Mr. Cottingham: "At the dairy experimental station at Kiel, ten cows are kept exclusively for the purpose of making experiments." This is a paper read before the Public Analysts' Society by Dr. Vieth, on the 15th March, 1882. He speaks of his researches at Raden, then at Kiel, and he brings out the result of his experiments at Kiel thus (*See* Analyst):—

"In the year 1878	Total Solids 12·43 per cent.	Fat 3·70 per cent.
„ 1879	„ 12·13 per cent.	„ 3·42 per cent.
„ 1881	„ 11·93 per cent.	„ 3·40 per cent.

"The solids not fat generally fall between 8·5 and 9.0 per cent."

Q. What do you say to this? A. I say that the whole of it is done by a different process; therefore it is not comparable with our 9 per cent. standard. I quite agree that from that process the standard would have to be lowered from 9 per cent. to 8·5. As we have no intention of changing the process, we cannot change the standard, and all that will not apply.

Mr. Cottingham: I have just one more question to ask you. Is the process suggested by this writer, Dr. Vieth, the best process or not? A. It is not in my opinion. It is not in Dr. Vieth's opinion.

Re-examined by Mr. Hopkinson:

Q. He is Analyst for a Dairy Company? A. Yes, he is Analyst for a Dairy Company.

Q. In that paper Dr. Vieth is speaking of the best way to get out the whole of the fat? A. Certainly.

Q. I suppose the Somerset House process, or the Soxhlet process, is a good way of getting out all the fat? Is it as good a way as the Wanklyn process or better? A. The Soxhlet process will get out more fat.

Q. Therefore certain things appear as fat which ought to appear as non-fatty solids? A. Yes.

Q. And therefore as a standard? A. It would be too low to be applicable to any other process.

Q. Have you by experiment yourself tried whether the use of that process or the Somerset House process does in fact take out something which is not fat, and which is weighed as fat? A. I have tried both. Soxhlet's method I have tried many times, and sometimes a considerable proportion of the non-fatty solids—milk sugar, is in fact brought out.

Q. And that appears in the analysis as though it were fat? A. Yes. I have tried the Somerset House process during the last three weeks, and I assert that something like 10 per cent on the average of what is extracted, when that process is strictly carried out, is not fat, but milk sugar.

Q. Have you tried a number of samples and analysed them by both the Wanklyn process and the Somerset House process? A. Yes, about 30 samples.

Q. As the result of those analyses, which method do you think is the better method for arriving at the amount of solids not fat? A. I do not think that any two persons can work alike by the Somerset House process, and I do not think it will give you reliable results.

Q. The same milk may give different results in different analyses by the Somerset House process? A. Yes, that I found by actual experiment.

Q. Have you found the Wanklyn process, with the same milk, always give the result? A. Not exactly the same, but a man who understands the work properly would not make a difference of more than one-half per cent. of water.

Q. The Wanklyn process substantially 'gives constant results? A. You have it here in three different analyses by different men, by the Wanklyn process, unknown to one another; the water does not differ more than ·2 per cent.

Mr. Cottingham: One goes up as high as 10 per cent. of adulteration. There are not two who agree.

The Witness: I purposely omitted one—the 10 per cent.—that is a fourth.

Mr. Hopkinson: If you used the Somerset House process for a number of samples, would you be sure that that standard was too low? A. I do not think you could possibly take that for founding a system upon. The Somerset House process could not possibly be taken for founding a standard upon.

Q. Is the reason of that, that in the Somerset House process, or the Soxhlet process, you take out as fat a great deal that is not fat? A. That is part of the reason; but I think two more reasons should be pointed out. The instructions given for the Somerset House process are not definite instructions as to dryness.

Mr. Cottingham: Pardon me, I must object to this. This gentleman cannot possibly tell what instructions are given at Somerset House.

The Witness: I am referring to Dr. Bell's printed book. I will alter my answer by saying Dr. Bell's process, if you like.

Mr. Hopkinson: You take the instructions as to time given? A. I take the instructions as to time. I say it is not a specific drying down to a certain point for which instructions are given; the instructions are that it is to be dried only to a pasty condition. There are no two of us in this Court, even chemists, who would agree exactly as to what a pasty condition is. Then if that condition is altered ever so little, the amount of milk sugar extracted would be altered.

Mr. Hopkinson: I have more witnesses whom I might call, but I only propose to call this next gentleman, Dr. Blyth.

Dr. ALEXANDER WINTER BLYTH, sworn.—Examined by Mr. Hopkinson:

Q. I think you are Medical Officer of Health and Public Analyst for Marylebone? A. I am.

Q. Do you think the Wanklyn process is a substantially fair one for arriving at whether milk is adulterated or not? A. I do.

Q. If that process is used, what should you say is the proper minimum standard to adopt for the non-fatty solids? A. A safe limit is 9. I have always held that it is too low; but still I think it is a safe limit to work with, and I work with it. According to my individual experience it is too low. I have never found a healthy cow give milk so low as 9 although I work to that limit.

Q. As applied to the analysis of milk of a dairy, would you say Mr. Estcourt's method being used that milk had been watered if the non-fatty solids fell below 9—could you say so safely? A. Yes.

Q. I think you have actually written a work on the subject of milk analysis, and you have paid great attention to the subject? A. I have.

Q. With regard to analysing decomposed milk, can you obtain any trustworthy results from it? A. Only under certain conditions; under ordinary conditions you certainly cannot.

Q. Would you say, that adding to the actual results of your analysis so much for loss by decomposition per week would bring you to any accurate results? A. No, that would be most unjust; because I have found from experiment that, if pure drinking water is added to milk, the decomposition is very much less than if water containing sewage contaminations is added to milk. There you get a different growth altogether; you get different microscopic appearance, and the growth is very much more rapid.

The Recorder: The growth of decomposition? A. Oh yes. The growth of microscopic organisms are the cause of decomposition.

Mr. Hopkinson: If there were an average, would that lead to grossly inaccurate results as to a particular specimen? A. Yes.

Q. If the original composition of milk is sought to be arrived at by an analysis of the milk when decomposed, and an addition is made to it of so much per week for loss by decomposition, would you say that the result was untrustworthy? A. Certainly.

Cross-examined by Mr. Cottingham :

Q. Do you mean to say that you cannot safely analyse any milk after a certain number of days—how many days ? A. I could not state the time, and I never said that. Of course if the adulteration is very large you can tell even in putrid milk.

Mr. Cottingham : What do you say is the interval of time from the milking of the cow within which a sample should be analysed—what is maximum interval ? A. I could not say at all. It may be very great under certain conditions ; in cold weather or in an ice-house it might be analysed a year after.

Q. Say in the months of April and May. How many days do you say might intervene so as to leave a sample in a sufficiently reliable condition ? A. It is impossible to say, unless you tell me the conditions under which that sample is kept.

Mr. Cottingham : I think, Sir, it would probably be the most convenient thing for me to call my witnesses, and then address you afterwards. Mr. Gully does not object to that course.

Mr. RICHARD WARDLE, sworn.—Examined by Mr. Ferguson :

Q. You are a farmer at Weston Underwood, and the appellant in this case ? A. Yes.

The Recorder : Where is Weston Underwood ? A. In Derbyshire, about six miles north-west of of Derby, near Keddleston.

Mr. Ferguson : Does the morning milk and the evening milk go at the same time to Manchester ? A. Yes, both at the same time.

Q. I suppose it leaves your premises in the same state as it comes from the cows ? A. Exactly.

Q. Do you superintend the dairy arrangements yourself ? A. Generally.

Q. You never put water in the milk ? A. There is not a drop put in.

Q. Nor do you allow other people to put it in ? A. I always order them not to do. I have always given strict orders that none should be put in.

Q. At some farms they rinse the cans out with a liberal allowance of water ? A. That is the case very often, but we do not do it with ours.

Q. Did you see this milk sent off, about which this complaint was made ? A. Yes, I did.

Q. Were your cows at the time in the fields, or kept in the sheds ? A. Altogether in the sheds.

Q. It is not a good time of the year for the milk ? A. It is generally considered a very poor one. It is generally weaker at that time of the year as far as our experience goes.

Q. Why is that ? A. I really cannot tell. I know that it is a result, so far as our observation goes with cheese-making. We can always make a very much greater amount of cheese in the autumn than we can during the spring months, from the same quantity of milk.

Q. I suppose it has something to do with the food ? A. Yes, and then the period of the year—the milk is not supposed I believe to be so good just after calving, and cows calve just about that time of the year.

Q. I suppose at that time of the year you eat up the remains of the winter food. A. Yes, and food has not been good at all during the last few years—during these wet seasons.

Q. Wet seasons make a difference ? A. A very great difference in the fodder.

Q. And consequently in the milk. I believe you are a Member of the Farmers' Society ? A. There is a sort of association in Derbyshire.

Cross-examined by Mr. Gully :

Q. How many cows have you ? A. We vary a little.

Q. How many had you in April ? A. 33 or 34.

Q. In how many cans would their milk be put in the morning ? A. Two at that time.

Q. Do you mean that there would be the milk of 16 cows put into one can ? A. Something like that. There were two full cans.

Q. It would represent an average of about 15 or 16 cows—each can ? A. Yes, I suppose so—something of that sort.

Q. You have had complaints about your milk from Mr. Halewood ? A. Mr. Halewood wrote to me in January. That was the first and only complaint I had from him.

Q. Did you see him ? A. No.

Q. Did he shew you an analysis he had got ? A. He wrote and told me he had had an analysis made.

Q. Did he tell you that he had had the milk analysed and that he had found that it was adulterated with 7 per cent. of water? A. I do not know whether he named the amount. He said it was adulterated, that he had had an analysis made and that there was so much water in it. I do not remember the amount.

Q. Was that in January? A. In January.

Q. Was it in January that you stopped what you called rinsing? A. After I got that note from Mr. Halewood.

Q. You never began it again? A. I never began it again at all. I may say that the rinsing was about half a pint at the end of the milk.

Q. Did Mr. Halewood complain or speak to you in April? A. Yes, but he never made any more complaints to me.

Q. There used to be some water put in up to January? A. Yes, just as I tell you.

Q. He complained and said that he had got an analysis shewing that there was an adulteration with water? A. Yes.

Q. Then you stopped the rinsing, and his complaints stopped? A. He did not complain afterwards.

Q. How many men do you employ about the cows? A. One with the cows directly—only one that attends to the cows. As to milkers, there are four—three men and a boy.

Q. When the milk has been got, is it poured into the refrigerator? A. It is poured out of one

Q. Through the refrigerator? A. Over one.

Q. Does that refrigerator consist of a winding pipe and worm, with cold water in it? A. It is a straight bar like *this*, something [meaning the bar round the witness-box] with water running through the inside.

Q. Is there a tap at the bottom of that? A. Yes, there is a tap to allow the water to come in. It comes in at the bottom and gradually goes up to the top and goes over the top.

Re-examined by Mr. Cottingham:

Q. You say there was this trifling addition of water from the rinsing. What is the rinsing? A. Supposing you had milk in a vessel, we put say half a pint—that is usually the case.

Q. A half pint of water? A. A half pint of water.

Q. To clear out the milk at the bottom of the vessel? A. Yes.

Mr. Gully: Mr. Ferguson said "a liberal allowance."

Mr. Cottingham: What do you say is the contents of the vessel into which you milk? A. About three gallons.

Q. Then there would be a certain amount of milk left in this vessel? Yes, hanging round the side.

Q. For the purpose of washing it out you put in how much? A. About half a pint.

Q. You rinse it and then put that into the churns for sending off? A. Yes.

Q. After you had this complaint from Mr. Halewood you desisted from that? A. Yes; there was not a drop of water put in.

Q. You never had a complaint after? A. No.

Q. You told my friend you saw this milk taken from the cows and sent off yourself, and you were present during the whole of the time? A. Yes.

Q. So that no water could have been added without your knowledge? A. There could not.

Q. You positively swear there was none? A. I do.

Q. How soon was the milk sent off after the milking? A. Immediately.

Q. You saw the cows milked, you saw the milk sent off, you were present the whole time, and you swear there was no adulteration with water? A. I do.

Dr. JAMES BELL, SWORN:

The Witness: Seeing that in our position we are perfectly neutral as between the defendant and the other side, and seeing that there are grave charges made against us, and that various criticisms have been made upon our various processes, perhaps your Worship, instead of allowing either Counsel to examine me, will allow me to meet all the points that have been brought forward without any direct examination.

The Recorder: Long experience in Courts of Justice teaches us that that is not the best way.

The Witness: I have not supplied material to either counsel.

The Recorder: I dare say not.

Mr. Cottingham: You are subpœnaed by both sides? A. Yes, I am.

Q. You are subpœnaed by those who instruct my friend, and you are brought down here on the part of the magistrates? A. Yes.

The Recorder: Keep to your leading questions. It is a mere matter of form. You must examine the witness.

Examined by Mr. Cottingham:

Q. You are the Principal of the Laboratory at Somerset House? A. I am.

Q. How long have you been in that position? A. I have been now ever since 1874 or 1875. I was then appointed Principal. I was Deputy-principal before that.

Q. Had you been in Somerset House in any other position before you were appointed chief? A. As Deputy-principal of the Laboratory.

Q. How long have you been in the Laboratory altogether? A. Practically in the Chemical Department since the year 1852.

Q. Under the Food and Drugs' Act you were appointed referee? I was.

Q. You have examined, I suppose, a great variety of articles for the Customs' Board, the Board of Admiralty, and samples of adulterated food? A. Yes.

Q. At the request of the Magistrates for the City of Manchester, did you analyse two samples of milk sent up to you in this case? A. Yes, I did.

Q. Nos. 203 and 204? A. Nos. 203 and 204. In the case of 203, the non-fatty solids were 8·20 and 2·82 of fat, but they slightly differ in the certificate I think. Those are the results I have averaged in pencil from the book. I do not know whether it corresponds within $\frac{1}{10}$ or $\frac{1}{100}$ with what you have.

Mr. Gully: 8·20 and 2·80 is what we have? A. Yes, they were done in duplicate. In the second case, No. 204, the non-fatty solids were 8·04 and 8·01. I suppose it will be about 8·02 in the certificate!!

Mr. Gully: And 3·01 fat? A. Yes, and fat 3·01. So that here we have 8·20 of non-fatty solids in No. 203, and 2·80 fat, making together 11·00, and to that we added $\frac{38}{100}$ for loss by decomposition, making together 11·38. In the other case the non-fatty solids were 8·01 and the fat 3·01, and adding $\frac{38}{100}$ to that makes 11·40 of total solids. Now in the case of No. 204, it will be noticed that Mr. Estcourt made the total solids 11·43, and on the hearing of the case before the magistrates I was perfectly ignorant of the result of Mr. Estcourt's analysis, when I stated that our allowance for loss through decomposition was $\frac{38}{100}$, so that we practically agree within a few hundredths with the result obtained by Mr. Estcourt, and in the other case a similar agreement occurs.

Mr. Gully: I think not; it is between 11·00 and 11·21? A. Then with regard to the scale of allowance, that is founded on a long series of carefully conducted experiments; and from those experiments we have deduced the ordinary amount of decomposition, or loss that occurs through decomposition, in the samples by keeping—and our scale is founded upon those results. That method is perfectly scientific, and a similar arrangement occurs, for instance, in the determination of the specific gravity of beer upon which our Board pay a drawback of over half a million a year; and the mode in which the scale was determined was founded upon actual experiments in that case; and the system or principle is exactly similar and analogous to the principle that we have adopted in the present case for making these allowances on kept milks.

The Recorder: If I understand you aright, with the addition of ·38 per cent. for decomposition, you do arrive practically at the same analysis as Mr. Estcourt arrived at without making any allowance for decomposition? A. Yes, quite so.

The Recorder: If that is so, that part of the case becomes unimportant.

Mr. Gully: Except upon the question whether the addition is a thing of any value.

The Recorder: If they both arrive at practically the same analysis, then the result must depend upon whether the amount alleged on the one hand to prove adulteration is conclusive proof of the adulteration or not.

Mr. Gully: Except this—that they do not arrive really at the same analysis. The analysis of No. 204 is 8·02 as against 8·62; and, in order to make the two correspond, Mr. Bell adds on a figure to represent an allowance, which addition is no part of his analysis, but a figure taken, as he says, as the result of his experience, as the average allowance which should be added on in order to make decomposed milk 21 days old correspond with fresh milk. That is not part of his analysis.

Mr. Cottingham: Yes, it is.

Mr. Gully: I say it is not.

The Witness: I say it is part of the analysis.

The Recorder: I do not care. In the view I am taking at the present moment—I daresay it may be a wrong one—it does not seem to me to be important as to how he arrives at it. Supposing he is wrong in his analysis, you are wrong too.

Mr. Gully: I do not follow you.

The Recorder: If you both arrive, by whatever road, at practically the same conclusion, you are either both right, or both wrong.

Mr. Gully: No. By this process of his, and by our process we ought to arrive at different conclusions. The same figure does not denote the same milk if arrived at by the two processes.

Mr. Cottingham: But the results of the analysis are practically the same in both cases and by the same sets of analyses.

Mr. Gully: I say that, supposing Mr. Bell, with fresh milk, had produced the result of 8·58 of solids not fat, or 11·38 total solids, that would correspond to a higher figure with us.

The Recorder: Yes, but I suppose you are prepared to take your stand upon the analyses which you have made.

Mr. Gully: The fresh milk analyses.

The Recorder: Then you are agreed about that?

Mr. Gully: I say that there are three fresh milk analyses which all bring out a figure which is inconsistent with the first figure of Dr. Bell, and Dr. Bell makes them consistent by adding on a figure which is not found in his analysis.

The Recorder: I quite agree with you; but when you have arrived at this it does not signify, for the purpose of this enquiry, how you arrive at the conclusion, if you are all agreed that on the 24th April this milk had in it a certain amount of solids fat, and a certain amount of solids not fat. How does it signify upon this enquiry how the conclusion is arrived at?

Mr. Gully: Because we say that Dr. Bell's 8·60, which he brings it up to, means a higher thing than our 8·60. I should be quite content if it were put that his 8 60 means no better milk than our 8·60; then I should be prepared to accept that.

The Witness: I am prepared to agree to that.

Mr. Gully: We are going upon the basis that I accept what Mr. Bell says. He says that by his additions he brings out the same result as Mr. Estcourt. But take for example No. 204. It is an important point. The non-fatty solids were 8·02. Adding Dr. Bell's ·38 to that makes 8·40 as against our 8·62, shewing that he does not profess that they are made to accord.

The Recorder: What he says now is that practically they have arrived at the same conclusions by different roads.

Mr. Gully: Decomposition would not destroy the fat. It is not the fat that would be destroyed by the decomposition; it is the other materials, therefore the ·38 would go on to them.

The Recorder: Is that so?

Mr. Gully: Is not that so, that the waste by decomposition would be in the non-fatty matters and not in the fat. A. Quite so.

Q. Therefore the ·38 would be put on the 8·02 and would make 8·40, and comparing that with 8·62 it would not bring them to the same figure? A. Only Mr. Estcourt has got some fat in his non-fatty solids, which accounts for the difference. (Mr. Estcourt here denied that he used the same process.)

Mr. Gully: You cannot have your pudding and eat it.

Mr. Cottingham: You cannot have your fat and attribute it to our non-fatty solids. That is the mistake you make.

The Recorder: Mr. Estcourt says that his non-fatty solids amounted to 8·67. Dr. Bell says from his non-fatty substances he arrives at 8·20.

Mr. Gully: Dr. Bell says that a certain amount has disappeared. We say that is not correct.

The Recorder: I see now what I could not understand before. You are very nearly agreed as to what the non-fatty solids were when the milk was fresh. I do not see that there is much difference between you.

Mr. Gully: There is a considerable difference.

The Recorder: According to Mr. Estcourt, the non-fatty solids were 8·67.

Mr. Gully: Arrived at by his process.

The Recorder: According to Mr. Bell his calculation produced 8·58.

Mr. Gully: Assuming it were done upon fresh milk.

The Recorder: It seems to me a very small difference.

Mr. Gully: It is what our witnesses were going into in some detail. They say that their process ought always to shew in pure milk at least 9 or 9·3 per cent. of non-fatty matter and; they say that if you apply to the same milk Dr. Bell's process, you would have as a result less than 9 or 9 3. You would have a smaller result upon the very same sample by applying Dr. Bell's process; therefore the figures do not compare.

The Recorder: I understand that. Now, what I mean is: that you have both arrived at the conclusion I have just mentioned, whatever your processes may be. It seems to me that you are placed in this difficulty; that if you shew that Dr. Bell is wrong, you have to shew that you under-estimated the non-fatty solids.

Mr. Gully: If Dr. Bell accepts our view that no pure milk ought to have less than 9 per cent. of non-fatty solids, those figures prove our case.

Mr. Cottingham: They do not indeed. The Recorder is perfectly right.

Mr. Gully: He will be glad to hear you say so, Mr. Cottingham.

The Recorder: If you shew that Dr. Bell's process does produce a less amount of non-fatty solids than your process does, then no doubt you would be able to shew that this milk is better than you make it. That is all.

Mr. Gully: No, it does not come to that.

The Recorder: It does.

The Witness: Most certainly it does.

Mr. Gully: Even allowing the ·38 to be added, it is not so.

The Recorder: Assuming at the present moment that the figures come to be the same, then if you prove that Dr. Bell's process of analysis of the same milk produces a less quantity of non-fatty solids than the Wanklyn process, then you will have proved that this milk was better than Mr. Estcourt says it was.

Mr. Gully: I think not, for this reason—Dr. Bell's 8·20, speaking somewhat roughly, would, I believe, correspond to the 8·67 brought out by our process.

The Recorder: That seems to be so.

Mr. Gully: I agree in that. I submit if that were so, then this would shew a result got out by him of 8·67 or 8·58 by our process. I am leaving out the ·38 altogether, though I agree it is a most important question. The two points upon which I rely are these—first of all that pure milk cannot shew less than 9 per cent. of solids, not fat, and secondly that you cannot rely at all upon the analysis of a decomposed specimen of milk.

The Recorder: I perfectly understand. With regard to the second point what I am now saying is. Why need you care about whether Dr. Bell's analysis is comparatively worthless or is valuable, if it produces the same results as you arrive at?

Mr. Gully: *If* it does, I quite agree. Why need I,——but I should like to know what Dr. Bell's evidence is before I say that.

The Recorder: Do you follow me?

The Witness: Quite so.

Mr. Gully: If he says that this milk when fresh was only worth 8·67 even if tested by our process.

The Witness: Our results agree with yours.

Mr. Cottingham: The results are the same. The scientific conclusions to be drawn from those results are *toto cælo* different.

The Recorder: I understand quite and am prepared to give my decision upon it if necessary. That question of decomposition appears to me not to be a question of value now in this appeal, as I understand the case at present.

Mr. Cottingham: It never was.

The Recorder: Let us have it perfectly clear, because these subjects are perhaps almost as new to me as they are to you, so we had better have no misunderstanding. What I understand is this: that Dr. Bell practically does not differ in his analysis of this milk from Mr. Estcourt.

Mr. Cottingham: Except in the process used.

The Recorder: In the analysis.

Mr. Gully: If he does not, and if he accepts this—that this milk when fresh, tried by Wanklyn's process, produced only 8·67, then that is all he is asked to admit about it. Then I say, further, that that is the proper process.

The Witness: Your Worship, I agree as to the figures. The learned counsel is wrong in saying that the process used by Mr. Estcourt is Wanklyn's process. It is not. I say that he has practically lapsed into our drying to a constant weight (Mr. Estcourt here demurred to this statement); therefore we agree in our results. That is the explanation of it.

Mr. Gully: If it be so, perhaps you will let the conviction stand at once.

The Recorder: I am sorry to interrupt you so often, but this is quite a novel kind of question to me. Mr. Wanklyn and Mr. Estcourt I daresay might arrive in ninety-nine cases out of a hundred at the same result, but they do adopt a different process in one particular: one of them weighs the fat and the other weighs the non-fat, and they deduct the other weight; but the conclusion they would come to would nearly always be the same? A. Yes.

Mr. Gully: I will call it Estcourt's process. According to our evidence, the thing is the same for all practical purposes. The admission that we should like to have, if Dr. Bell is prepared to go so far, is this: that testing by Mr. Estcourt's process—which I shall ask you to say was for practical purposes the same as Wanklyn's—testing properly by that process, when the milk was fresh, the analysis shewed that the solids not fat were 8·67. That is the first point. Then I should ask, further, that where you find that result taken by that process it shews an adulteration, in so far as it shews a result less than 9 per cent. of solids not fat.

The Recorder: Yes, I quite understand it. That point Dr. Bell does not agree with.

The Witness: That is the second part of the question.

The Recorder: There has been a good deal of evidence about that first point, but that point disappears now, and the time has not been at all thrown away.

Mr. Gully: Do not let me for a moment mislead you in this. I do not say that the other process of Mr. Bell by which he adds on that allowance for decomposition is correct. I think when you hear the rest of Mr. Bell's evidence in which he will question our process, you will find that that quession is material.

The Recorder: I can understand it being a most interesting question, but I do not see that it affects the matter now.

Mr. Gully: If, when Mr. Bell's evidence is over, you say it does not affect it, I will not say anything.

The Recorder: Then I will discharge both of you from any further argument with regard to the process by which the parties mutually arrive at the analysis which was made by Mr. Estcourt, and which is admitted now on all sides to be substantially correct. Now the point in question is, whether that analysis proves in criminal courts beyond all reasonable doubt that there must be water in the milk.

Mr. Cottingham: That really is the ultimate question.

Mr. Gully: I quite agree.

Mr. Cottingham: Of course you know what Wanklyn's analysis is? A. Yes, I have stated so.

Q. I presume you have resorted to it upon certain occasions and you rejected it? A. Yes, we first tried Wanklyn's process most religiously. We tried to work it, but we found it varied so in the same sample done in the same way that we did not continue it. It varied from 2/10ths to 8/10ths of difference —I believe that I am not overstating it, and I think that in Mr. Hehner's paper which has been read before the Court to-day it will be found that the range is nearly the same.

Q. From ·2 to ·8? A. At all events from ·3. I remember it varied from ·3 to ·8. The great difficulty was to dry samples always to the same degree of dryness, in the three hours—in other words, to dry off the same amount of moisture from the milk in that time. Sometimes a film will get over the top of the milk when it is put over the water-bath, and so on, and that will interfere with the evaporation. Hence we adopted the other process—that is, to dry the non-fatty solids to constant weight, and we determine the fat as well as determine the whole of the constituents. The reason that the difference arose was this: that if you put two quantities on the water-bath—that is, equal quantities of milk in the capsules, and then at the end of three hours you removed them, and extracted the fat from them, you might practically get the same result or the same quantities of fat from each; but when you deducted it from the total weight which you ascertained in each case, at the end of three hours there would be a difference which varied from 3/10ths to 8/10ths; consequently, seeing the uncertainty of getting the evaporation carried down to the uniform scale or quantity always, we were obliged to abandon the process. I have no doubt that is what is suggested entirely in the spirit of Mr. Hehner's paper, of which I entirely approve.

The Recorder: Now will you tell me, in popular language, what is the process that you adopt, which is, you say, a better process? A. We always make our experiments in duplicate. We weigh out two quantities, they are put on the water-bath until they attain near dryness, not quite—not quite so much as if evaporated for three hours, but until the moisture is practically gone or really gone. We then take and treat them with pure ether, and extract the fat from the total solids.

The Recorder: Are you certain when you extract the fat from the total solids that you do not extract some other solids at the same time? A. Quite so, because we are most careful. After the fat is separated and dried, we are most careful to dissolve the fat with dry ether, and ascertain whether any portion of the non-fatty solids has been dissolved out besides the fat. That is the invariable practice; so that we prove absolutely that we extract nothing from the total solids except fat Then, having separated the fat, we put the non-fatty solids in the bath, and we dry them to constant weight.

The Recorder: What is the meaning of that? A. That is to say until they cease to lose weight. Then we get them dry. The fat is treated in the same way. We do not determine one constituent and deduct it from another, but we determine the whole of the constituents, and the two added together ought to make the total solids.

The Recorder: Whereas Mr. Wanklyn after his process weighs the non-fatty solids? A. The fat.

Q. And then deducts the weight from the other, and whereas Mr. Estcourt weighs the non-fatty solids and then deducts it from the other, you weigh both? A. Yes.

Mr. Cottingham: And compare the sum of the weights with the total solids? A. Yes.

Q. So that by that means you furnish a test for the accuracy of your analysis? A. Yes.

The Recorder: When you weighed the two together and then deducted the one, did you practically ever find any difference between that, and the weight of the two together? A. Not if the total solids are properly dried.

Q. Did you ever practically find that they had not been? A. With sour milks there is a difficulty in getting them to agree exactly; but the results are within practical agreement.

Q. Then there is no advantage in weighing each? A. We have to be extremely careful in arriving at reliable results—results that we can defend and produce to the court.

Mr. Cottingham: Do you think it would be safe to simply weigh the total solids and then weigh the fat, by whatsoever means extracted, and deduct the weight of the non-fatty solids? Would that be without any check of weighing the two? A. I have explained to his Worship, that by doing that you have no evidence whatever as to whether the water has been entirely expelled from the milk—no check whatever.

Q. In fact you would have no check, and if you have duplicated your experiment you may repeat a mistake? A. Yes, there may be a repetition of the error, or it may be greater.

Q. There can be no mistake if you weigh the fat and weigh the non-fatty solids, and if the sum of the two weights equal the weight of the total solids? A. Quite so.

Q. That is a crucial test.

The Recorder: Have you often to make use of the double weighing in your calculations. A. We make use of it in every sample.

Q. Do you find that it is often of use? Does it ever produce different results? A. Sometimes a difference of 1/10th; that is within the limits of an error of experiment between the two methods.

Mr. Cottingham: Would not a very small error in the amount of the solids cause a considerable error in the calculation of the amount of adulteration by water? A. I do not see the point exactly.

Q. From a certain amount of non-fatty solids Mr. Estcourt infers the presence of 4 per cent. of added water. Supposing Mr. Estcourt, for want of the test you have mentioned, went wrong in the weight of the solids, would that cause a considerable difference in the amount of added water? A. I understand his Worship has decided that question, and that we have gone from it. I understand your Worship that we agree——

The Recorder: Do not say that I have decided. It is a conclusion I have arrived at, that you do agree.

Mr. Cottingham: You agree as to the analysis, but not as to the conclusion to be arrived at from it? A. Of course, our certificate shews that.

Q. Do you consider that the weighing of the fat in the manner that you have described, after drying it, is very essential in coming to a proper conclusion as to the amount of the solids? A. Of course; if we did not we would not do it.

Q. Now after having analysed the milk in the manner in which you have described, have you found anything in the milk which is not perfectly consistent with genuine milk? A. Oh, no; it is perfectly consistent with a sample of genuine milk.

Q. You can find nothing that indicates adulteration? A. If we had we would have stated so. Of course we are perfectly unbiassed in that respect. An attack has been made upon our Tables——

The Recorder: I was coming to that afterwards for my own satisfaction, but I thought I would leave that for the present. I should like to hear what is the explanation given of the difference between the specific gravities.

Mr. Cottingham: Perhaps you will explain that now before we get further? A. It was a very interesting matter, and we made several experiments on the subject. On page 11, the last paragraph, you will find I have dealt with the subject. I state "An indirect method of arriving at the percentage of fat and non-fatty solids was suggested by Mayer & Clausnitzer, and recently a modification of their formula for calculating the result has been proposed by O. Hehner. The method is based on the accurate determination of the specific gravity and total solids of the milk, and the application to these of certain experimental data derived from the specific gravity of the fat and non-fatty solids. The theoretical results, however, which are calculated from even the modified formula proposed by Hehner, are in most instances too high in the non-fatty solids, and to the same extent too low in the fat; but the amounts are sufficiently near accuracy, especially in the case of samples of average quality." There is the point of difference. I found a considerable agreement always when they were samples of average quality, but not when they deviated from samples above or below average samples. If your Worship will turn to page 20 and refer to the two cases that were pointed out by Mr. Wigner, 1028·35 the specific gravity, and 10·42 the non-fatty solids, and 5·66 of fat, your Worship will see at once that that is a sample far above the average, both in non-fatty solids and in fat. The fat is 5·66 and the non-fatty solids 10·42.

The Recorder: Let me remain at that. What he says is, that it is unreasonable to assert that milk, the specific gravity of which is 1028·35, should have so large a percentage of non-fatty solids and of fatty solids. He says it is unreasonable to suppose that such a thing with such figures as those could co-exist? A. When it is worked out according to the method laid down by Mr. Hehner, the result does not correspond with the results given in this table; but I say that this is not an average milk. The non-fatty solids 10·42 are very high, and the fat 5·66 is very high; and therefore I should expect a considerable deviation.

Q. Then what he says is, that if it is good milk the specific gravity ought to be higher? A. No, because it contains nearly six per cent. of fat, which reduces the specific gravity. The more fat, the lower the specific gravity of the milk.

Q. Where did you get these analyses on Table V.? A. Those are all milks that were carefully collected. I deputed one of our gentlemen to go to different parts of the country, and see the cows milked. He brought these samples up direct to the laboratory to us, and they were analysed. Those are the results of the analyses of the samples we obtained ourselves from the dairies under the different farmers.

Q. Take the other instance, the 1035·56. That is a high specific gravity? A. Yes, and there the non-fatty solids are 9·71 and the fat 4·13. There the fat is not so high as it is in the other case where the specific gravity is 1028·35.

Q. Although the figures are surprising, you still think they are not so surprising as to suggest any doubt to your mind as to their being correct? A. I think it will be shown presently by Dr. Voelcker that they are correct. He has shewn me two instances of his own, and the results are quite as abnormal as these are, or at least differing as much from the ordinary averages.

Mr. Cottingham: These specific gravities, and the solids put opposite to them, are not the results of theory but what you have ascertained by actual analysis? A. Yes. I have told his Worship that the whole of the samples in this Table V., also those in Table VI., are of our own obtaining, and can be authenticated as genuine milk.

Q. As authenticated facts? A. Yes; the gentleman who did it was one of the officers of the Board, and therefore he was a responsible person.

The Recorder: A perfectly responsible person and an intelligent person might make a mistake, but you do not think those are mistakes? A. I do not.

Mr. Cottingham: Would you come to this conclusion with regard to Mr. Wigner's theory—do you say it does not apply to the extreme or limit cases? A. Quite so. We find considerable variation.

Q. And you say that these instances here are facts outside his theory? A. Yes, I have stated to his Worship so.

Q. Supposing that in the analysis of this milk you had proceeded on Wanklyn's mode, would you or would you not have obtained a higher amount of fatty solids?

The Recorder: We have disposed of that?

The Witness: We have disposed of that. The question now, as I understand, is whether milk containing 8·6 of non-fatty solids—whether the milk in the present instance is adulterated.

Mr. Gully: We are not agreed.

The Recorder: I agree with you, Dr. Bell, about that.

Mr. Gully: I put it as I did before———

The Recorder: I was merely simply saying that the question for me is whether milk, the analysis of which is like this, must necessarily be adulterated or not.

Mr. Gully: By analysis obtained by a certain process—that is all esential. A different process upon the same sample will produce different results.

The Recorder: I am assuming that your process upon this sample is a correct one. Somebody else by another process has arrived at the same result.

Mr. Gully: It is enough for me———

The Recorder: I do not say that the process *is* a correct one. I do not go so far as that; but I say that the process you adopted has brought you to the same conclusion.

Mr. Gully: As to actual contents ?

The Recorder: Yes.

Mr. Cottingham: The real question between us is this: Assuming that both sets of analysts arrive at the same results, are the conclusions from those results the same, and if not which is correct?

The Recorder: Yes.

Mr. Cottingham: In the analysis of this particular milk do you bring the amount of non-fatty solids within some of the instances in your own table? A. Yes. In the case of individual cows—that is in the tables as published here—nearly 40 per cent. of the samples fall below 9 per cent. of non-fatty solids, and in the case of dairy samples nearly half of them fall below 9 per cent. of non-fatty solids. Analysed more minutely, in Table V., there are 14·9 per cent. under 8·6.

Q. Begin at page 22. Table V. spreads over those four pages? A. Table V. commences at page 20. I say that 14·9 per cent. of the samples fall under 8·6 of solids not fat. 28·9 per cent. are over 8·6 and under 9·00, and 46·00 per cent. 9, and upwards. The variations in the non-fatty solids range n the tables from 1 per cent. up to 11·27 per cent.; and the fat ranges from 1·92 to 6·87. There is only one sample so low as 1·92.

Q. Where is that? A. That is on page 22, the last line but one. Your Worship will notice that that is a sample which would have passed the standard of the Public Analysts so far as non-fatty solids are concerned.

The Recorder: I do not understand your view about that.

Mr. Cottingham: He is speaking now of the fat.

The Recorder: I do not understand for what purpose you mention that? A. Simply the range—to point out to your Worship the variations that occur in the various constituents of milk.

Q. What you meant to show was that in some milk the weight of fat and non-fatty solids differ very much? A. Yes.

Q. This you mention as an extreme case? A. Yes.

Mr. Cottingham: And that, notwithstanding the high specific gravity? A. We have passed that. Then in the case of dairy samples the range of non-fatty solids is from 8·5 to 9·91. That is taken from Table VI.

The Recorder: Then what were those other samples? A. Individual cows. The others are dairy samples. As to those, since this case was heard before the Magistrates I have looked over the samples in our books as to the places from which we obtained them. I notice that we obtained some from Draycott, Keddleston and Duffield. At Draycott, taking individual cows, the non-fatty solids were 8·6, the next one 8·97, the next 9·09, the next 8·5, the next 8·95, the next 9·12.

The Recorder: You say they are lower than the general average of the country? A. That was at the end of March, and we should have expected at that time that there was not much grass; and any grass there would be would be moist, and that necessarily affects the character of the milk.

Q. Is that, or not, considerably lower than the average? A. No, I think these results somewhat correspond with the results in Table V., taking them as a whole. Then at Keddleston the non-fatty solids were—8·64, 8·35, 9·03, 9·59, 9·93 and 8·82; and the average of 17 cows at Keddleston yielded 8·70 of non-fatty solids, and 3·21 of fat.

Mr. Cottingham: Many of those samples—if not all—are from the neighbourhood where the defendant has his dairy? A. Yes. The average sample in the dairy samples stands about 6 down the Table VI.

Q. This Wanklyn standard of 9 per cent. was fixed a great many years ago? A. Yes. I think it was fixed about the year 1874, or so.

Q. Was that before the passing of the Adulteration Act of 1875? A. It was.

Mr. Cottingham: Do you consider fat an important ingredient in the analysis in coming to your conclusion? A. Yes.

Q. In fact you consider all the constituents—their proportion to each other? A. We do. We take the whole of the constituents into account in dealing with the sample.

Q. Did you find in this milk the normal proportion of constituents to each other? A. Yes, quite the constituents of genuine milk.

Cross-examined by Mr. Gully:

Q. Do you adopt my friend's phrase, "normal proportion"? There was rather an excess of water, was not there? A. I cannot say there was an excess of water.

Q. I am right in saying that this does not shew the normal proportions of solid matter to water? A. The range in the variations of the various constituents of milk are so great that this falls quite within it.

Q. You would get at an average? A. It is below the average.

Q. Then it is not the normal proportion; it is below? You rely upon the Table? A. I rely upon the Table as the result of experiments and investigations.

Q. Were all these analyses your own? A. They were all made under my own superintendence.

Q. For the purpose of experimenting to see what was the standard? A. For the purpose of ascertaining or investigating variations in the composition of milk.

Q. A number of these results are very abnormal ones, are not they? A. They are wide—the range is very wide.

Q. Fat 1·92 is very out of the way? A. It is low.

Q. Leaving this book out of the question altogether—if someone brought you a specimen of milk containing only 1·92 of fat, would not that raise strong suspicion in your mind of skimming? A. If a Public Analyst reported a thing of that kind I should consider the case one in which the defendant ought to prove that it was genuine milk.

Q. You would not think it unreasonable for anyone to come to the conclusion that there had been skimming? A. No, I think that is fair and reasonable.

Q. The same with a great many of these low figures for non-fatty solids? A. Yes, when you go below 8·5 I think there should be some evidence on the part of the defendant that the milk is genuine.

Q. Take for example the third item on page 22. The specific gravity is 1027·05. That is a low specific gravity, is not it? A. Yes. It is poor milk. It has only 8·00 per cent. of non-fatty solids.

Q. It is a low specific gravity, and a very low amount of non-fatty matter—8·00 only? A. Yes.

Q. That is very low? A. We have had lower, only I have not included them. I thought it in the public interest not to do so.

The Recorder: 8·00 is the lowest I see here? A. Yes.

The Recorder: You must assume it is abnormal? A. Yes.

Mr. Gully: Do you say that was genuine milk? A. Yes, I do.

Q. You are quite sure that was genuine milk? A. I have no doubt whatever at all about it.

Q. Would you pass milk that was brought to you for analysis like that? Supposing the Court sent up to you, at Somerset House, a sample to analyse which contained only 8 per cent. of non-fatty matter, would you pass it? A. No, I should not. As I say, I consider that in all these cases the defendant ought to be called upon to shew that the milk was genuine.

Q. Supposing you found non-fatty matter 8·00 and fat 2·31, would not you certify, if that sample were sent to you, that it had been adulterated? A. If it were represented as a dairy sample.

The Recorder: I suppose what you mean by that is, that the combined milk of 16 cows, producing non-fatty matter, 8·00, and fatty matter 2·31, would be so astonishing that you would not believe it? A. Quite so.

Mr. Gully: The 8·00 alone would be quite enough, would not it? A. Yes, we should not pass it.

Q. If that were sent up to you as a specimen without your being told that it was milk from a single cow or from a dairy, would not you refuse to pass that, and say that it had been adulterated? A. Yes, I daresay we should; but I may remark, that in cases of this kind, where it comes on the border line, I have invariably written to the clerk of the magistrates to ask some particulars as to the history of the sample.

Q. What is the lowest that you find in your dairy samples? A. 8·50, I think.

Q. After adding this ·38 in this case you only bring this up to 8·58? A. Yes, I think that is so.

Q. 8·50 is the lowest of the dairy samples, and is somewhat abnormally low? A. It is a low sample of course.

Q. Would you pass milk at 8·50? A. If the sample of milk in every respect afforded evidence of being a genuine sample we should pass it.

Q. What do you mean by that? Supposing a sample like this were sent up to you containing 8·50 of solids not fat, would you pass that as a dairy sample? A. It is a very general question, because we take the fat into account.

Q. Does that affect the question of adulteration by water? A. Of course it does. That is just the difference between the Public Analysts and us. We take the whole of the constituents into account. We have every desire to support the Public Analysts as far as we can, but we have always to consider the others as well. If it goes below a certain point, I say that the defendant ought to be called upon to shew that it is a genuine sample.

Q. You have to certify—that is the duty you have to perform? A. We have to consider the results before doing that.

Q. I ask you, would you not certify that a sample had been adulterated, if sent up to you containing 8·50 per cent. of non-fatty solids? A. No; because there might be 4 or 5 per cent. of fat upon that.

Q. You would not do more than say that it was a suspicious circumstance? A. We should say that it was of low quality for a dairy sample.

Q. It would raise an inference? A. It might really be a very rich milk. If that contained 5 per cent. of fat it would be very rich milk indeed, very much richer than milk having 8 or 9 per cent. of non-fatty matter and 2·5 of fat.

Q. Then 8·50 you would pass? A. Yes.

Q. You would pass 8·4? A. That would depend upon the fat. If there was a good quantity of fat, or a reasonable quantity of fat, we should.

Q. Did not you say before that you would pass 8·4, and that you would not pass 8·3? I did not give the answer as it is stated there, nor may I give you an answer in the same form in which it is given there, because I qualify it. If it contained 8·4 of non-fatty solids and a fair proportion of fat, and the ash and other constituents were satisfactory, or shewed evidence of a genuine sample, we should pass it.

Q. I want to know if this is correct—"Would you pass it at anything under 8·5? A. I should. Q. Would you pass it at 8·2? A. No, I should not. Q. Would you at 8·3? A. No. Q. Nor at 8·4? Yes, if the other constituents were right."

Q. You draw the line somewhere between 8·3 and 8·4? A. If it comes below that point I say the defendant ought to be called upon to shew that the sample was a sample of genuine milk.

Q. Are those results as to non-fatty solids obtained by your process? A. They are.

Q. Take that one which by your process brings out 8·00. If, instead of testing by that process, you had tested in the way Mr. Estcourt had tested, would not that have brought out a larger figure. A. As I have stated from the beginning, by Wanklyn's process we might get 8·3 or 8·4.

Q. You would get a larger figure? A. You might.

Q. Would you expect a larger one? A. Yes.

Q. With less heating? A. Yes.

Q. With your system you apply more heat, and dry more? A. Yes, we reduce to constant weight.

Q. Then as to non-fatty matters, the results are not the same if you test a given quantity of milk by your method and by his process? A. Not if you strictly adhere to his process.

Q. Or by Mr. Wanklyn's process? A By Mr. Estcourt's process you will get the percentage, because he dried to constant weight.

Q. He did not say so? A. He did.

Q. Not practically? A. Practically it was dried to constant weight.

Q. He said he dried for a certain time (three-quarters of an hour I think it was), which left only 5/100ths or 6/100ths of moisture.

Mr. Gully: You found 8·02 in one of those samples? A. In the Tables—yes.

Q. Take it by itself. Practically 8·02 is the same thing as 8·00, there is only ·02 difference—practically we may take it that as low as the lowest, although it is a dairy sample? A. It is not one of the dairy samples.

Q. I say that the 8·02 is a sample from a dairy—it was the milk of 15 or 16 cows?

The Recorder: I think you are wrong, Mr. Gully.

Mr. Gully: I was saying that the sample which he produced, No. 204, showing 8·02 was a dairy sample? A. Yes, that is so.

Q. I will leave out of consideration the addition, or allowance you make for decomposition. That sample came out as low as the lowest of the samples from individual cows, and lower by ·5 per cent. than the lowest dairy sample you have in your Table VI.? A. Quite so.

Q. That was the actual analysis, and you added something on for decomposition? A. We did.

Q. Assuming that that was correctly added on, even when you added that ·38 for decomposition, you only bring it out 8·40, which is lower than the lowest dairy sample in your Table VI by ·10? A. Yes.

Q. 8·50 is the lowest. There are two 8·50, one 8·62, one 8·70, and one 8·80? A. But there is over three per cent. of fat in that sample, which shows 8·02.

Q. There was 8·02 solids not fat, and there was 3·01 of fat in the sample you took of No. 204. In your lowest dairy sample in Table VI. there was 8·50 non-fatty solids, and 3·65 of fat—still more? A. Yes, we got over three per cent. of fat.

Q. What I am pointing out is that it is lower (even after you have corrected it), both in non-fatty substances, and in fatty substances, than the very lowest of all the dairy samples in Table VI.? A. It is only 1/10th.

Q. You made it as high as you did make it only by adding that ·38? A. Yes.

Q How do you get at that ·38? A. By the results of experiments made as I pointed out at the beginning—we made an investigation.

Q. Is that an average? A. It represents on an average the amount of loss that occurs.

Q. Is that the average of figures which varied a good deal like Table V.

The Recorder: I do not quite see the value of this, Mr. Gully.

Mr. Gully: If this test is valueless by reason of adding on ·38, and there is no authority for doing it, there is then left only the 8·02, which would be admittedly bad.

The Recorder: You have not quite followed that which I thought was the result of the former part of the discussion, that by either of the scientific processes adopted by them they both arrive at the same conclusion, or they have arrived at the same conclusion by a happy accident. In either case both sides are agreed that the condition of the milk at the time when it was examined, was that which Mr. Estcourt has described. Then what does it signify how he has arrived at the result?

Mr. Gully: I submit that it is material in this way. We say that, tried by our process, this sample shewed solids not fat, 8·67. That, if it had been pure milk, would have produced at least 9·00; therefore it is bad. We say that this gentleman's process produced a lower result than ours, somewhat; and we say that in point of fact he did produce, by this analysis of No. 204, 8·02; and we say that if you are to take his analysis to check ours—which we deny, considering that we had other independent analyses made at the same time—if you are to take his analysis as a check against ours, then I say it is open to two observations. In the first place, we object to his method of doing it, which we say reduces the matter of solids, a fact which you will have present to your mind; and in the next place, I say that he cannot add anything to that 8·02, because it is a mere question of luck whether he hits the right figure or not. It may be quite true that it is the average of a number of results obtained with regard to the loss by decomposition; but you cannot tell where in that average this particular milk would stand. I say that when you have had the milk tested, while fresh, by scientific men who have agreed upon positive results, this gentleman cannot correct his figures by a mere average, which may not apply to this particular case at all. Supposing the average amount of loss by decomposition to be ·38, that may be the average between a loss ranging from ·001 to ·5. You may very well imagine a very large range. How can he tell what the loss was in this particular case. It may be a case in which the amount of loss was very small.

The Recorder: In my view, this at present has been proved—that this milk when analysed produced the figures which Mr. Estcourt has stated. The calculations made by Dr. Bell with regard to all the other specimens of milk, were made upon a different system from that which Mr. Estcourt adopts, and Dr. Bell's system would only produce a smaller amount of non-fatty substances, but so small an amount as to be almost inappreciable, where Mr. Estcourt's is said to be inaccurate.

Mr. Gully: I follow; but it seems to me that the importance of it is this. Here you have, as I was saying, an analysis taken at the time the milk was fresh and what my friend really relies upon in this case, is not merely Dr. Bell's critical observations upon our process, but on the fact that Dr. Bell made an analysis of his own, which he says bears him out in his opinion. I want to show that that ought to be set aside altogether, and if you tell me that you cast aside Dr. Bell's examination and analysis of this milk altogether, that you discard it from your mind, and attach no weight to it, I have nothing more to say.

The Recorder: I am not going to say that I discard it from my mind and attach no weight to it; but I so far discard it from my mind in deciding this case, that I think it is of no importance in the decision of this case at all.

Mr. Gully: Then I do not know that it would be any use for me to go further.

The Recorder: I do not say to a gentleman of Dr. Bell's eminence that I discard his evidence altogether. It would not be true, to begin with, but I do not think it is an element which will assist me in coming to the conclusion at which I shall have ultimately to arrive.

The Witness: Perhaps your Worship will allow me to say this: The evidence upon which we rely to shew that our method is not quite a rule of thumb, or an average is this:—the allowances are not invariable, as I pointed out before. Mr. Hehner in this case made the non-fatty solids 8·29, and he made the acid $\frac{18}{100}$. We find the acid only a few days afterwards $\frac{23}{100}$. He came down only a little lower than we did.

The Witness: I want to satisfy the Public Analysts, as well as the counsel for the prosecution, that we do not do things, even in making this allowance, altogether by rule of thumb. We have evidence in the sample itself. It is acid, and that increases according to the degree to which the decomposition has proceeded.

Mr. Gully: Mr. Hopkinson is with me to-day, and he was in the case when it was before the Court below: perhaps you will hear him upon this point, and why he thinks it is important.

Mr. Hopkinson: It is in this way—the two processes really arrive usually at different results. The Somerset House process usually makes the fatty substances rather more, and the non-fatty substances rather less than the other process. by reason as Mr. Wanklyn said, of a certain part of the milk sugar being dissolved and carried over with the fat. The Somerset House people have no doubt done their best to make a proper analysis, but their fallacy is this: they are trying to compare this analysis of Mr. Estcourt, made by Mr. Wanklyn's method, with a standard arrived at by their method. That is the fallacy.

The Recorder: It appears to me, if they stated that, that there would be a fallacy in it, but the difference is so very small that it does not signify.

Mr. Cottingham: My friend is in error.

The Recorder: What I understand is that Dr. Bell's process of analysis will give a different amount of constituent parts of milk from Mr. Estcourt's, but if Mr. Estcourt's analysis is accurately taken, the difference between the result of Mr. Estcourt's analysis and Mr. Bell's is so small that it does not matter.

Mr. Hopkinson: It applies here—Dr. Bell gets his standard from an analysis of fresh milk, applying his own process. He analyses a sample of this milk by his own method, but plus a certain rule of thumb, which our witnesses have proved, may be totally inapplicable to the sample. He may have arrived at a result tallying with ours after applying that rule of thumb, but he arrives at a totally different result when he sets up the correct standard of milk.

The Recorder: It appears to me that this difference is one of those small somethings that it does not seem possible to give much weight to in a question of this sort. I admit it exists.

Mr. Hopkinson: Of course neither of those methods may be quite accurate in the amount of non-fatty solids they arrive at; but according to the Somerset House people, they say that our method leaves too much in the non-fatty solids, and we say that their method leaves too little.

The Recorder: I quite admit that that would be a matter of very great nicety, but it does not appear to me that the difference is such that I could decide what is practically a criminal case upon it, if it means that.

Mr. Hopkinson: We put it rather in this way. We have proved that 9 is the lowest minimum according to our method. Dr. Bell's evidence does not touch that for a moment. He does not say that for Wanklyn's method 9 per cent. of solids not fat is not the proper standard; he only says that by another method that is not a proper standard.

The Recorder: If I understand Dr. Bell rightly, he says that 9 per cent. taken correctly by the Wanklyn method is too high a standard.

The Witness: That the result is not accurate.

Q. Do not you also say this: that although there may be variations in Estcourt's method, yet where it is accurate, it produces 9 per cent. of solids not fat from milk, it is still possible that that milk may be unadulterated? A. If Wanklyn's process is followed exactly, the probability is that it will be accurate, or within certainly a few tenths of the method followed by us; but I gather that in the present case the contention is not between Wanklyn's process and our process.

Q. Not at all? A. Inasmuch as our process agrees with the process followed by Mr. Estcourt in this case.

Mr. Sutton: I appear for the Justices, and if I may be allowed to say so, there is a conspicuous fallacy in the mind of the Court and in the mind of the witness. So far as regards this particular question, what the witness says is quite true: the result has become the same. But what we say is that your process is uncertain, in consequence of the fact that you not only dry your solids in a hot water-bath, but that having dried them in a hot water-bath, you then take your solids out of it, and dry them in a hot water-oven, and the effect of that is that the heat you are able to apply to these solid substances varies so much from circumstances, over which you have no control, that the standard you arrive at in each individual instance is different. You get no certain result. Therefore, this table of analyses, or standard you have prepared, having been prepared by a process which in itself is so liable to uncertainty as to be worthless, cannot be brought forward to test the analysis of a sample of milk which we have obtained by a process which is certain.

The Recorder: I entirely agree with your argument. I suppose that it is want of habit in expressing an opinion on such a scientific question as this that obscures what I say. What I mean to say is that the whole question is that which you have raised. I express no opinion as to the conclusion you draw. If it can be shewn that Dr Bell's system of analysis, which shews that it may be good milk, is fallacious, then his standard becomes worthless.

Mr. Sutton: That is a question of fact.

The Recorder: It is a question of fact.

Mr. Sutton: As a matter of fact, what has been left out of sight by the Court is this: that our witnesses, who came into the box, did state that Bell's process cannot be relied upon. Mr. Bell now goes into the box and says: "It is admitted by you that my process is to be relied upon."

The Recorder: No, all Mr. Bell says is: "My process has, by some marvellous means, brought out the same as your process."

Mr. Sutton: In this particular case.

The Recorder: I quite agree, Mr. Sutton, that the important question is whether it is possible the milk, unadulterated, can have so low an amount of non-fatty substances as 9 per cent.

Mr. Cottingham: The standard of 9 per cent. for non-fatty solids was Mr. Wanklyn's test, which must be taken, together with Mr. Wanklyn's process. Mr. Estcourt has not adopted Wanklyn's process, but he has adopted Wanklyn's test, arrived at by another process than that which he has used.

Mr. Gully: We say that he has used Wanklyn's process.

The Recorder: Do not ask me my opinion, or I should give it. My opinion is that practically he has done so.

Mr. Cottingham: That we deny; therefore he has no right to set up that standard.

The Recorder: Again I repeat what I have before said: the only question that presses me in the case is whether it is, or is not possible, or consistent that milk which only has in it this amount of non-fatty matter is unadulterated. The knowledge that it does contain only that amount of non-fatty solids may be arrived at I do not care how.

Mr. Gully: The only difficulty is one which I have to deal with before I get to your question, that is, that it is material how it is got at. We say that 8·67 of non-fatty solids, by Dr. Bell's process, is the same thing, or nearly the same thing as 9 by our process.

The Recorder: Then go on if you think so.

Mr. Gully: That is what I say the evidence is.

The Recorder; Going upon that point, I cannot help thinking that the process by which you have arrived at that point is wholly unimportant. I quite agree that the real question is whether these experiments are worth anything if they are taken by a process different from that used by Mr. Estcourt.

The Witness: You will allow me to repeat, that they rely upon the non-fatty solids to determine whether the milk is adulterated or not. Mr. Estcourt has distinctly stated that he dried the non-fatty solids practically to a constant weight, and consequently he has adopted essentially our process.

Mr. Gully: We differ from that entirely.

The Witness: That is my argument in the matter.

Further cross-examined by Mr. Gully:

Q. Supposing it was tested by Wanklyn's process and produced 9 per cent., and then you took a sample of the same milk and tested it by your process would it further reduce the weight? A. That would have to be ascertained.

Q. Supposing you took a sample of precisely the same milk and tested it by your process, which as I understand would reduce the weight more than Mr. Wanklyn's process would, would yours come out to about 8·6 or 8·7? A. At the beginning I pointed out that it varied from 3/10ths up to 8/10ths.

Q. There we differ again. Would it not vary at least to that extent? A. To what extent?

Q. Would not you by your process reduce what they brought out at 9 to 8·6 or 8·5? A. It might, or to 8·3. But Wanklyn's process has not been applied to this case. There is confirmatory evidence in the matter, because we have Mr. Hehner's results.

The Recorder: Let me see that I understand it. That is a larger difference than I thought existed between your two estimates.

The Witness: Your Worship, the whole thing depends upon the non-fatty solids being dried to constant weight. Mr. Estcourt has admitted that he dried them to constant weight and that is the essence of our process.

Mr. Gully: Mr. Estcourt never did say so.

The Recorder: I know exactly what he said.

The Witness: Therefore I say he has adopted our process, and it is clear that he has adopted our process because it is confirmed by the amount we added to make up for the loss by decomposition, and it is almost confirmed by the result obtained by Mr. Hehner, because he obtained from the same sample 8·29, which contained $\frac{18}{100}$ of acid. We obtained from the other portion of the sample 8·02 with $\frac{28}{100}$ of acid; clearly shewing that the whole thing was done according to our method and one result confirms the other.

Q. Is it the fact that Dr. Duprè is a gentleman, as he has told us, of very large experience in these things? A. Oh, yes; he is a man of considerable ability and experience.

Q. We have had a number of gentlemen here who have every day practice in this matter, and on whose certificates hundreds of people have probably been convicted and that without appeal; do you say that those gentlemen are all under an error in putting 9 per cent. as a safe standard, at which, to say adulteration has taken place? Do you say they are all wrong? A. I think Dr. Duprè will admit that he does not act upon that standard.

Q. Do not let us go off upon that. Dr. Duprè told us that in every case where he found it under 9, he had certified that there had been adulteration, and in every such case there had been a prosecution and conviction without appeal, and he had always put the amount of adulteration as from 9·3 when he certified, but that he did not certify unless the non-fatty solids were under 9. Do you say that all those gentlemen are wrong altogether, and that they have been certifying all this time upon a totally wrong basis? A. The cases have not come under my observation.

Q. Has there been any case in which anyone against whom Dr. Duprè has certified has sent the case on to you? A. No, not an instance.

Q. Do you say that this is error on their part altogether, and that in future they must alter their proceedings altogether, and while they test by the same process they are to reduce their figure to 8·3, 8·4 or 8·5? A. I know this: as a matter of fact——

Q. Do you say that?

The Recorder: He has to give his evidence as to fact and not to consider the result of it. It is like trying to terrify a jury to prevent them from bringing in a verdict of guilty against a man because of the frightful consequences.

Mr. Gully: It is a question of science. I am asking this gentleman whether he says as a scientific chemist that that basis, which has been followed so long by so many chemists who ought to understand their business, is erroneous.

The Recorder: I will answer the question for him. He says it is wrong.

The Witness: I know as a matter of fact that there are well-known analysts in London that would not think of recommending a prosecution for so small a percentage.

Re-examined by Mr. Cottingham:

· Q. Have you ever certified for a prosecution for adulteration for so small an amount as 4 per cent. of water? A. We have.

Q. In what case? A. A case in Hammersmith, in which it was about 4 per cent.

Q. Then there was a considerable difference in the amount of fat as well? A. No.

Q. Under what circumstances did you certify in that case? A. It came down to a point at which we were perfectly justified in doing so.

Q. After investigation? A. Yes.

Mr. Gully: You have certified for a prosecution where there had been adulteration to the extent only of 4 per cent. A. But not on the 9 per cent. standard.

The Recorder: I am not in the least biassed by what has been done before.

AUGUSTUS VOELCKER, sworn.—Examined by Mr. Cottingham:

Q. You are Doctor of Philosophy, and a Fellow of the Royal Society, and Chemist to the Royal Agricultural Society? A. Yes, and I have been for the last twenty-five years concerned in chemistry, and connected with the Chemical Society of England. Previous to that I was fourteen years Professor of Chemistry in the Royal Agricultural College of Cirencester.

Q. You have had a very large and lengthened experience in the analysis of milk and other articles of food? A. Yes, extending over a good many years.

Q. Have you turned your attention particularly to the composition of milk and the circumstances affecting its composition? A. Yes, I have done so.

Q. You have found that the variations as regards the solid matter are considerable? A. Very considerable; in fact all the constituents, without exception, of milk are subject to variations. The variations are greatest in the case of fat, and less in the non-fat; but still they are variations in the proportion of the caseine or curd which constitutes solids not fat—variations between the curd and milk sugar and mineral matters; so that you have no constancy in the composition of the milk which varies with varied circumstances—for instance, the time of the year, the food given to the cows, and also the breed of the cattle. There are some cows which, if their milk were analysed alone by any Public Analyst, would be universally condemned, and perhaps justly so in a certain sense, as being below the reasonably fair good quality of milk. I speak of the Dutch cows. I find that there is sometimes as much as 90 and 90½ per cent. of water, and the totals of solids scarcely more than 10; but the fact is that you get such a constancy of composition in a large town because the milkmen understand their business and they work up to the constancy of the Public Analysts. There is a regular technical name amongst milk dealers—they know how to "*blend*" their milk. They buy from poor country districts—the very crust of the land—milk which is generally poor, and blend it with milk which is kept in the neighbourhood of towns, by cowmen who deal largely in milk, who feed richly and produce milk which is rich in all constituents. You may get as much as 10 or 10½ of solids not fat, and as much as 4 to 5 or 5½ of solid fat, and by blending those together they can produce milk which comes up to a given standard. That would account in a measure for the apparent uniformity of results that you obtain by analysing milk as supplied to towns.

Mr. Cottingham: You have been in Court while Dr. Bell was giving his evidence, and you heard his evidence? A. Yes.

Q. Do you agree with that evidence? A. Yes, I do in all essential particulars.

Were you also examined as a witness in the Committee Room on this bill? A. Yes, and I strongly opposed the notion of fixing a standard, because a standard has a tendency, which I foresaw then, to this: that the milk dealers would work up to a given standard; and what they do at the present time is, they allow the milk producers to skim off partially the milk, and yet, by blending with non-skimmed milk they bring it up to the standard required by the Public Analysts, whereas a most valuable portion is now deliberately taken off—the cream is taken off from the milk and the standard is still maintained; and milk which unquestionably is skimmed is frequently sold as perfectly genuine, and milk which is genuine, but falls below the standard of 9 per cent. of solids not fat, is condemned, and injustice in that way is done and has been done.

Q. You have, in your experience, known numerous instances of milk falling below the standard of 9 per cent. solids not fat, yet still being genuine milk? A. I have.

The Recorder: That is a question of importance. Do not answer that hastily. Do you mean that in your experience you have tested milk which has fallen below the standard? A. Below 9. With your permission I will give those instances, or hand them over to your Worship afterwards. As early as 1863, I published a paper in which I gave the average composition of 22 samples of milk taken from a herd of cows.

Mr. Gully: By yourself? A. By myself. In fact our students at the College, at the time I was Principal at the College, complained of the quality of the milk. I was struck with the milk being very poor at the time, and I enquired into the circumstances. This led me to make an investigation of the influence of the time of the year, and when the cows were milked, on the quality of the milk. I analysed the milk of the whole herd. It was not for sale, but merely for the supply of the College. Sometimes we had not enough. There were about 15 cows, I believe, at the time, and I analysed the milk from those cows every month twice, the morning and the evening milk, for eleven consecutive months, with the exception of August, when I was away for the vacation. I found then that of the 22 samples of the milk of the whole herd, 9 samples contained less than 9 per cent. of solids not fat, and one of the 22 samples contained as much as 10·7—there was in round numbers 10 per cent. of solids not fat; and another contained as little as 7½ per cent. of solids not fat. Thus you have here a range of 7½ to 10, that is 2½ difference in the solids not fat.

The Recorder: Were all those cows fed the same? A. All fed in the same way. Then during the last four years the British Dairy Farmers' Association give prizes for milking cows that produce not only the largest quantity, but also the richest milk, taking into consideration the quality as well as the quantity, and by assigning certain points for quality, and certain points for quantity, we are able to say at the conclusion which are the best milking cows. Therefore, you may rest assured that no cows are sent up but those in good condition, the really good cows and well fed cows; but I find that the influence of race is very great, as, indeed, every milk dealer knows who has any experience in the milk of Alderneys or the milk of the large breed of cows, the red Oxfordshire old cow, or the Shorthorn and the Dutch cows—one is very much richer than the other. I found the following results, in the following years, with individual cows which were separately milked in my presence, with the exception of this year, when I could not be present, but my son was present, and the milk was received by me for analysis: In 1879, 1880, 1881 and 1882, I was present all the time they were milking when the samples were taken. I took the samples myself and bottled them up, and they were analysed in my laboratory. I found in 1879, in four samples out of twelve, less solids not fat than 9 per cent.; eight varied from over 9 up to 10. Then, in 1880, at the Dairy Show, I found that all the Shorthorns and cross-bred cows (there were only four shewn for competition for the milk prize) contained on an average somewhat under 9 per cent. of solids not fat. Every one of the four cows that were shewn, or competed for the milk prize, produced milk, the solids not fat in which were under 9 per cent. Some came very near, but they were under 9 per cent. Four out of six cows, of the Jersey and Ayrshire class, gave milk containing less than 9 per cent., five contained about 9; and seven cows out of nine, in the Dutch class, yielded milk containing less than 9 per cent. Then, in the Dairy Show for 1881, seven samples out of fifteen contained less than 9 per cent. of solids not fat.

Mr. Gully: Those are your own samples? A. My own samples.

Q. And your own analyses? A. My own analyses, that is to say in the sense in which Dr. Bell has explained, made under my own immediate superintendence, mostly by my son, and done in my laboratory, and I was there present all the time. Seven out of fifteen samples contained less than 9 per cent. of solids not fat. Two samples contained less than 8 per cent. of solids not fat, and another sample contained as much as 10½ per cent. Then last year, in 1882, out of twenty-six samples nine were found to contain less than 9 per cent. of solids not fat. This year comparing a few samples taken from seventeen cows which competed for the milk prize, three out of seventeen gave less solids not fat than 9 per cent.

The Recorder: What were those cows—what sort of cows? A. They were mostly Dutch or cross-breds—large cows. You will seldom find in the Jersey or Ayrshire classes that they yield less than 9 per cent. of solids not fat; generally above. You may find as much as 10½ solids not fat. So that you see how difficult it is to fix anything like a standard. I do not know whether I may be permitted to make any remarks on this question of standards.

Mr. Gully: I would rather that my friend asked questions. I must really ask my friend to conduct his case in the usual way.

The Witness: I find that the standard adopted in Paris is 11 per cent. total solids, of which 3 per cent. ought to be fat, which leaves solids not fat 8. I think that is a very reasonable standard; 3 per cent. of fat makes it high. If you ask me the question, Is the standard adopted by the Public Analysts fair or low or high, I should say———

Mr. Gully: This is not evidence. This is a sort of historical lecture. It is impossible to check the process by which they say this is to be ascertained.

The Recorder: It is quite open to that objection.

Mr. Gully: 8 there may mean precisely the same thing as 9 here.

Mr. Cottingham: Are these measurements you have given us the same? A. Yes, the kind of method which is adopted would not produce any practical variation.

The Recorder: The impression upon my mind has been for some time that any scientific process would not make any very great difference.

Mr. Cottingham: That I quite agree with. The question here is the conclusion to be drawn from these analyses.

The Witness: I was going to remark that if I were asked whether the standard adopted by the Public Analysts was a low or a high one, I should say it is decidedly too low a one, because they do not require a fair average proportion of fat. You may expect during the greater period of the year a higher percentage than 2½ of fat. The average is much nearer 3 than 2½. It is only in exceptional cases of very poor food or in the spring of the year, in March or April, when the grass is just springing afresh and is immature, and rainy weather sets in, and where you have an additional quantity of water given with the food, that the milk is exceptionally low; but throughout nine months of the year I should say by the adoption of the Public Analysts' standard a sort of legal right is given to milk dealers to skim their milk and to sell milk of too low a quality, for I need not remind your Worship that 2 per cent. of solids fat is a great deal more valuable than 2 per cent. of solids not fat. They blend the milk together. It is a practice with many of the large milk dealers to keep chemists for the purpose of seeing that none goes out that is below the standard.

Mr. Cottingham: What do you say—Is 9 per cent. of non-fat too low. A. If I were to give a standard I would say raise your standard in fats—lower ½ per cent. in solids not fat, and screw up the milkman to really unskimmed milk. I am not prepared to recommend any standard, because although you may have in your own mind a sort of standard, you must apply it with discrimination and take into consideration even the price. I know that some milk dealers actually get 1d. to 1½d. more per gallon than others because their milk is so much better for blending.

Q. Have you seen the analyses in the case before the Court? A. I have.

Q. In your judgment it is impossible for any chemist to come to the conclusion that any water had been added as a scientific conclusion from these analyses, assuming those analyses to be correct? A. You cannot say it.

Q. You could not affirm that any water whatever had been added—that there was any adulteration? A. You could not.

Q. Then you come to the conclusion that these analyses are perfectly consistent with perfectly genuine milk? A. Yes.

Q. So that this milk which Mr. Wardle has been convicted of selling adulterated may be in your estimation perfectly genuine? A. Yes, taking into consideration the time o the year when the milk was sold, and also the probability of the fact that the cows had no concentrated food in the shape of cake or meal and were fed on the natural produce of the land.

Mr. Gully: We have had no evidence of that.

The Witness: Assuming that I have had no evidence upon the case if the cows were fed upon grass alone at that time of the year, all I can say is that it would be fairish milk, but rather poor for that time of the year.

Mr. Cottingham: 4 per cent. is a very very low amount of water to adulterate with? A. I do not think a man would risk his character for that.

Mr. Gully: Is this evidence that a man would or would not risk his character for the purpose of making money. It is not a question of risking character?

The Witness: I do not think he would do it for his own credit's sake.

Mr. Wardle: I am sure I would not.

Mr. Cottingham: Did you hear that paper of Mr. Hehner's read to day?

Q. Do you agree with what he says about a standard there? A. Quite. I quite agree with all Mr. Hehner has said.

Q. Do you agree with the paper I read from THE ANALYST? A. I agree with that.

Cross-examined by Mr. Gully:

Q. And you agree with Mr. Hehner's evidence generally to-day? A. Yes, I do.

Q. Do you differ from Dr. Dupré's evidence? A. With the exception of his fixing a standard for solids not fat at 9. I certainly do not agree with that.

Q. With the exception of that you agree with him? You are against all standards? A. I am against all standards.

Q. How would you test milk practically if you were a Public Analyst? A. There is the difficulty, because you cannot distinguish between naturally poor milk and watered milk.

Q. A Public Analyst has so much milk sent to him in a vessel. If you had not a standard how would you test it? A. I am glad I am not a Public Analyst to have to decide that question.

Q. You have no other theory as to how it should be done? A. No, as I said, because I must take all things into consideration; I certainly would analyse it, and if I found the milk below the standard that I have fixed in my own mind I would take means to get full particulars.

Q. I am speaking of this: supposing you were a Public Analyst, and were called upon to certify in a certain statutory form whether this milk had been adulterated or not. How would you ascertain whether it had been, or not, except by a standard? That is what Public Analysts' have to do; they are not allowed to go to the farm. A. The Government has carefully abstained from adopting a standard, and so has the Board of Trade.

Q. You have not offered any other resource. You arrived at 7·50 non-fatty solids with one sample. Was that from a single cow? A. That was a single cow.

Q. Can you shew any average of the milk of 15 or 16 cows giving less than 9 per cent.; I do not mean picking out exceptional cows? A. Yes, I can. That was 7·50.

Q. Was this your own experiment? A. My own experiment—that was 7·50, the average of 15 cows—the whole herd.

Q. Where was that? A. That was at Cirencester when I was resident there.

Q. When was that? A. The paper was published in 1863—that was in 1862 then.

Q. Was that a herd that had been starved or ill-fed? A. They were poorly fed; they had not enough to eat.

Q. They had been badly treated? A. Yes, they had not sufficient food.

Q. Supposing the Government had set up a standard, you would hardly let a case like that interfere with your acting.? A. No, I would not; certainly not. There is a danger of fixing the standard too low.

Q. Even under the shadow of the Royal College of Agriculture they had been starving. With the exception of that case, do you know any case where an average of the milk of 15 cows has given solids not fat below 7·50? A. No.

Q. Below 8·00? A. Yes.

Q. Where was that? A. 8 out of 22 where the percentage of solids not fat fell below 9 ———

Q. Supposing you take the 22. What is the average of the 22? A. With the exception of that one unusually poor, I have others with 8½ solids not fat, then 8½ again, 8·88 and 8·70.

Q. Then the others are over 9? A. The others are all over 9, some as high as 10.

Q. The average of the 22 would be higher than 9? A. Yes, it would.

Q. May we not take it that the average of that herd of 15 or 16 cows will be over 9? A. Taking it throughout the whole year, but not in separate months.

Q. As regards Dutch cows and so forth: Dutch cows are not imported for the purpose of being fed in Derbyshire, to supply milk in Lancashire? A. They are chiefly imported for the sake of the milk supply.

Q. Do you find in Derbyshire and Cheshire Dutch cows with that very small proportion you have told us of? A. No, I do not think they keep them in Cheshire. They are chiefly kept by milkmen in the neighbourhood of towns.

Q. When you analysed these what process did you use? A. I have used, I may say, every process which has been published at various times.

Q. In 1862? A. In 1862, I extracted the total solids with ether.

Q. How much milk did you take? A. I took various proportions from the determination of the total solids. I took out about 10 grammes, and for the extraction of the oil I took as much as 3 times the quantity—30 grammes—so as to get a fair average.

Q. How long did it take to complete an analysis from beginning to end. What time was spent over it? A. For practical purposes an unreasonably long time.

Q. How long, about? A. Perhaps some three days for each analysis.

Q. So that the milk would be ten days old by the time it was finished? A. Oh no, they were all done immediately the milk was taken. I had only two samples every month.

Q. Is it more accurate than it was then? A. I cannot say that; but for practical purposes you get sufficiently accurate results, with a plan like that of Wanklyn.

Q. You have not been a Public Analyst of any kind, nor had to certify for purposes of this kind? A. No, but I have frequently to report on milk, whether it is genuine or not.

Q. Do you find that the quantity of solid non-fatty matter varies according to the time of the year? A. Yes, the solid non-fatty matters.

Q. To what extent—within what range? I am not speaking of exceptional cases, but what do you find is the fair range that you can depend upon? A. I should say it ranges from 8½ to 9½ solids not fat.

Q. It varies to that extent—it ranges over one in fact? A. It ranges over 1, but you may have greater variations; I only give you the average.

Q. Is the 8½ arrived at by a process like Dr. Bell's? A. By the perfect extraction of the oil, which is difficult to realize by the adoption of Mr. Wanklyn's process. I am sure you will forgive me for saying so, but I have perfectly extracted it, even by Wanklyn's process.

Q. I want to follow what you really did. Did you follow the same process that Dr. Bell followed, preferring that to Mr. Wanklyn's, because you got a more perfect extraction of the fat? A. I prefer the extraction with anhydrous ether, or what is practically very strong ether, leaving all the watery portion of the ordinary ether out of contact with the dry residue, so that I can extract fully the oil.

Q. Is not it a fact that Wanklyn's process leaves a greater weight than your process? A. It may, or may not do; it depends how it is worked. I am sure Mr. Wanklyn would not leave much oil in because he does it perfectly.

Q. I mean in the way described by Mr. Wanklyn and Mr. Wilkinson? A. The tendency is that there is some oil left in the residue.

Q. Is the effect of that to make your 8·50 correspond with their 9, or thereabouts? A. It may, it has a tendency to increase the solids not fat.

Q. Roughly speaking, would that be about the difference that you would expect to find? A. The difference between what?

Q. The difference between the results of the analyses—the residuum of non-fatty solids left after treating the milk by your process, and by Wanklyn's process? A. You may have a difference of between 3/10ths to half per cent. even; it depends very much upon the quality of the milk; and what applies to one sample of milk, will not apply to another.

Q. Treating it by your process, would you say that 8·50 of non-fatty solids was a very low average for 15 or 16 cows? A. I should say that it was a fair average.

Q. Treated by your process? A. Yes, but rather low—below the average.

Re-examined by Mr. Cottingham:

Q. Was there anything in the constitution of this at all unusual—I mean do you find, in fact, all the constituents of genuine milk in this milk, according to the analysis? A. Yes.

Q. All the constituents of genuine milk, a fair proportion and proper quantity? A. Yes, and if I had had to report upon it, I would have returned it as genuine.

WILLIAM THOMPSON, SWORN.—Examined by Mr. Cottingham:

The Recorder: What are you? A. I am an Analytical and Consulting Chemist at the Royal Institution, and a Fellow of the Royal Society of Edinburgh; Member of the Chemical Society, and a Member of the Society of Public Analysts.

Q. Have you seen the analysis of this milk? A. I have.

Q. In your opinion does that analysis justify the conclusion that 4 per cent. of water has been added? A. I should think it does not justify any conclusion.

The Recorder: As to whether———? A. As to whether it contains water or not.

Mr. Cottingham: Is there anything in the analysis you have seen, either in the quantity of non-fatty solids, the quantity of fat, or anything else that is not perfectly consistent with genuine milk? A. I believe not.

Q. In point of fact, would you have passed such a sample as genuine if it had been submitted to you? A. I should form no opinion. I should say it might be adulterated or not adulterated.

Q. There is no evidence of adulteration? A. There is no evidence of adulteration.

Cross-examined by Mr. Gully:

Q. It is low? A. It is low.

Q. And would excite suspicion if put before you as an analyst? A. It might do.

Q. Are you a Public Analyst? A. I am not.

Q. Have you analysed milk to any great extent? A. I have done a large number of samples.

Q. Do you mean for farmers who have brought it to you? A. Yes.

Q. Or do you mean by way of experiment? A. For farmers, and by way of experiment also.

Q. Farmers often bring you their milk do they? Yes, we have a considerable number come.

Q. Would 8·50, the residuum left after Mr. Bell's process had been applied correspond to somewhere about 9 after Wanklyn's process had been applied? A. From my experience I should think it would not be so.

Mr. Cottingham: Do you agree with the evidence given by Dr. Bell and the last witness?

The Witness: Yes, I think I have answered the question by saying that there is no evidence so far as I know that it is adulterated.

Mr. RICHARD BANNISTER, SWORN.—Examined by Mr. Ferguson.

Q. I believe you are an analytical chemist in the laboratory at Somerset House? A. I am Deputy Principal in the laboratory at Somerset House, and an analytical chemist also.

Q. In your laboratory they examine articles for the Board of Trade and the Customs?

The Recorder: We had that from Mr. Bell I think.

Mr. Ferguson: You assisted in the analysis of this milk? A. I did.

The Recorder: You signed the certificate, did not you? A. Yes, and not only that, I saw all the weighings and calculated all the results as I always do in connection with milk cases, or any cases of adulteration.

The Recorder: As I have said before, I do not think this much signifies, because the results come to practically the same—so as to make no difference.

Mr. Ferguson: In your opinion the results arrived at are perfectly consistent with this being a genuine sample of milk? A. Just so.

Q. Now will you tell us how you analysed this milk? A. Is it necessary to go over the whole of it?

The Recorder: What does it signify. I may still be wrong, but I have said some hours ago that I do not think that is at all important, because this witness has arrived at the same conclusion with the Somerset House system, as Mr. Estcourt with his system. If their system is wrong, it is a very lucky accident that they happen to come to the same conclusion.

The Witness: I have not the slightest objection to give it to your Worship, but I want to save the time of the court in every way I possibly can. Dr. Bell has done it already.

Mr. Ferguson: Is there anything in the result of the analysis to lead you to the conclusion that the milk was watered? A. There is not.

The Recorder: We have his certificate with his opinion. You agree in the certificate? A. Quite so, or I should not have signed it.

Q. There was some other gentleman? A. Mr. Lewin: he is here in Court.

Q. It is a joint certificate? A. Yes.

Q. You all did agree? A. Exactly your Worship, or we should not have put out names to it.

Mr. Gully: I take it that this gentleman says the same thing, and that Mr. Lewin says the same thing as Dr. Bell.

Mr. Cottingham: We had another scientific witness to call, Sir, but there being a death in his family he is not able to be here. That is the case, Sir. I have only a few words to say——

The Recorder: I think I quite understand the question now. If any learned Counsel wishes to address me, I shall be glad to hear him.

Mr. Gully: Do you wish to call upon me?

The Recorder: If it is not a discourtesy, I think neither of you can throw any light upon it, or I am sure you would do so. I think I am sufficiently informed upon the matter now to form my decision. I think so.

Mr. Gully: I am quite content to cry quits with my friend upon that.

Mr. Cottingham: Then I shall not trouble you with any observations.

JUDGMENT.

The Recorder: This is a conviction under the Sale of Food and Drugs' Act, 38 and 39 Vic., cap. 63, and 42 and 43 Victoria, cap. 30.

The appellant, Richard Wardle, has been convicted in a penalty, by the Justices of Manchester, for selling adulterated milk, and he has appealed against the conviction upon several grounds. The first ground is that he is not guilty; the second is immaterial, I think; the third is a legal objection to the conviction; and that raises a question, perhaps, of some importance, viz., whether the certificate of the officers at Somerset House is conclusive or binding upon the Justices or upon the Court of Quarter Sessions.

With regard to this third ground of appeal, I am clearly of opinion that it is not well founded. The words of the 22nd Section are: "The Justices before whom any complaint may be made, or the Court before whom any appeal may be heard under this Act, may, upon the request of either party in their discretion cause any article of food or drug to be sent to the Commissioners of Inland Revenue, who shall thereupon direct the Chemical Officers of their Department at Somerset House to make the analysis, and give a certificate to such Justices of the result of the analysis," &c.

Now it appears to me perfectly clear that the object of the legislature was that in case of any error fallen into by the witnesses before the Justices in the county, that they should be corrected by the certificate sent by the authorities at Somerset House, and that the Justices or the Court of Appeal should have the advantage of such a certificate that they might form their judgment upon it; but I do not think that that at all takes away either the responsibility of the Justices or that of the Court of Quarter Sessions, who must give a perfectly independent decision upon the merits of the case, of course giving full weight to the opinion of the Chemical Officers of the Department at Somerset House; therefore, I think that that ground of appeal fails.

Now, in this case I have before me the oath of a person who says that he supplied this milk and that he did not in any way adulterate the milk; and in considering the judgment to which I come, I must take into consideration, not only the scientific evidence, but the facts of the case. I cannot conceal from myself, nor do I wish to conceal from myself, the fact that Wardle, the farmer, seems to have acted in a perfectly straightforward way. He at once sent the samples, taken from these milk cans, to perfectly independent analysts, who both gave a decision adverse to him. His conduct in that particular leads me take a favourable view of the statements he has made, that this milk was not in any way adulterated.

Then there comes the scientific evidence. That is a vast amount of evidence of the very greatest value, which goes to shew that the analysis—I decide entirely upon this analysis of Mr. Estcourt's—leads conclusively to the result that this milk was adulterated with water. A very great deal of scientific evidence is gone into to prove that conclusion.

Now, on the other hand, there is the evidence of the certificate of the Somerset House Analysts, which, I take it, I am to use for my assistance upon this trial; and if I am not to use it, at all events I have the evidence of the gentlemen who have given the certificate. They state that after "making the addition for natural loss arising from the decomposition of the milk through keeping, the proportion of non-fatty solids is not lower than is found in genuine milk. The percentage of fat and ash are equal to those found in genuine milks. From a consideration of these results we are unable to affirm that water has been added to the milk." The correctness of that certificate is, to my mind, corroborated by the fact that the analysis made some three weeks after the milk had come from the cows, for all practical purposes, produced the same results as that which was made by Mr. Estcourt; and that rather leads me to the conclusion that the analysis could not have been at all carelessly taken or slurred over by those gentlemen, Dr. Bell, Mr. Bannister, and Mr. Lewin. I assume then that the analysis of Mr. Estcourt was correct, and that the analyses of all these gentlemen, although not quite identical, were for all practical purposes correct.

Against the oath of Mr. Wardle, and against his general demeanour and conduct, I am asked to decide that this water was put into this milk, upon scientific evidence, which is contradicted by the scientific evidence of such gentlemen as those who have been recently called. This is a matter in the nature of a criminal proceeding; and to use an expression which is always used in criminal proceedings to juries—and I sit here as judge and jury in this case—I must be satisfied beyond all reasonable doubt that this man has been guilty of the offence charged against him; and I am not satisfied. If it were necessary I would express an opinion as to the propriety of the different systems of analysis which have been adopted, because, although I know nothing of science, after hearing such extremely good evidence as I have heard on both sides, if it were part of my duty, and I were bound to do it, I would give a judgment upon that question. But it does not arise, and I am not called upon in the present case, in the view I take of it, to give any decision whatever as to which is the best mode of analysis for milk. I ground my decision not certainly upon any opinion that either of the analyses was incorrectly conducted. I say that most absolutely. I might go further if it were necessary, only it is not necessary to say it—it appears to me that both analyses were skilfully and well conducted; but it is unnecessary for me to say that upon the present occasion judicially.

The conclusion I have come to, is, that the offence charged against this man is not made out to my satisfaction, and I do not know that there is any value or use in my saying anything more upon the matter.

I thought for a considerable length of time that it might turn out that an analysis made after the milk had been kept three weeks was nearly valueless; but when I find that after three weeks the analysis made turns out to be practically the same as that made when the milk was fresh, I cannot suppose that that is a matter of chance, but that it was the result of scientific investigation and enquiry. The investigation which has taken place in this matter is one that I daresay will be advantageous to both sides if I may call them sides—both to the parties who side with one system of analysis, and the parties who side with the other system of analysis, but I am not going into that to-day.

I have already stated that it has not been proved to my satisfaction that this milk was adulterated with water, and that being the conclusion at which I have arrived, I can do nothing more than confirm this appeal and dismiss the original conviction.

Mr. Cottingham: Now, Sir, there is a second conviction which I must draw your attention to. I hope you will give us the costs of this?

The Recorder: Yes.

Mr. Cottingham: There is the second conviction.

Mr. Gully: Does my friend want to try that? It follows the first I suppose?

The Recorder: Yes.

Mr. Cottingham: If it follows the first, that is dismissed also, and I have to ask you for the costs of that.

The Recorder: The costs will be taxed. There will be nothing on the second conviction.

Mr. Cottingham: I want to draw your attention to this: that there is one offence, and there ought not to have been a second conviction at all.

Mr. Gully: Does my friend want to argue that?

Mr. Sutton: In giving the costs you do not I apprehend give costs against the Justices?

The Recorder: Oh no.

Mr. Cottingham: Not for convicting a second time, for the same offence.

The Recorder: Certainly not. I will say—Appeal confirmed, Conviction dismissed.

ADULTERATION IN PARIS.

The *Revue des deux Mondes*, on June 15th, contains an article by M. Denys Cochin, entitled "Les falsificateurs et le laboratoire municipal," which is interesting, and in some respects amusing, and of which the following is an abstract.

The art of adulteration is now one of the most interesting sections of chemistry. In days of yore the milk dealer on the corner poured a little water into his tin cans, and the wine merchant in his cellar manufactured secretly by the light of candle his decoctions of logwood. But the milkman and the wine seller have progressed with the age, and their work has become scientific. They can consult dictionaries and systematic treatises on adulteration. Taking one of these as his guide, M. Cochin proceeds to draw up a bill of fare, with regard to which he acts the part of Sancho Panza's physician, who, it will be remembered, objected to every dish set before his master, on the ground that it was unhealthy.

The tapioca soup he finds is made of potato starch, contaminated with copper; the bright green pickles owe their color to the same metal. The fish has perhaps been preserved by an antiseptic salt; the sauce makes it palatable, but very few know what makes the sauce palatable. The butter which it contains is no longer made from cream by the help of a churn. Part of it is margarin, part of it is butter improved with gypsum, silicate of potash, sulphate of baryta, potato starch and coloring matters of various kinds.

The truffles with the roast are made of earth, potatoes and hycoperdons duly flavored. The peas and the spinach owe their beautiful green to copper.

The digestion of these products of the laboratory is supposed to be aided by coffee, cognac and a cigar. The coffee may contain chicory, beans, corn, carrots, caramel, sawdust and horse liver. The cigars are in a handsome box bearing Havana stamps, but are made of poor German tobacco, cabbage leaves, willow leaves, &c. And the brandy! The Omniscient alone knows what that is compounded of.

If the next morning after such a meal the diner feels dyspeptic and feverish, his physician will probably order him a glass of mineral water. This is probably made artificially. But we need follow M. Cochin no further in this enumeration, which is, after all, the same old story.

After a brief description of the municipal laboratory established in Paris for the purpose of detecting adulteration, a sketch is given of the objections made to this institution. The first is, that it is an encroachment on liberty, and the wine merchants, who are the most active enemies of the laboratory, lay great stress on this. They agree that it is wrong to add harmless substances to wine, but to dilute it with water—that is not adulteration; it is one of the rights of freemen.

And to a considerable extent their cause has become a popular one. The people, it is said, demand water colored with aniline dyes, and they have a right to have it!

In the second place, the merchants urge that the work of the laboratory is opposed to business prudence. The publicity of its results will injure the export trade. How dare we announce to the world that of 3,361 samples of wine the chemists have found 202 harmful, 1,093 passable, and only 357 without reproach? "Do you suppose," says M. president of the syndicate of wines and liquors, "that if there were municipal laboratories in Madrid, Valencia, Alicante, Genoa, &c., and samples of wine were sent to them as is done in Paris, do you suppose, I say, that they would not find the same proportion of adulteration that is found by the Paris laboratory? I answer, yes; and were this matter a hundred times more important, the Spanish and Italian laboratories would keep their figures to themselves, and would not proclaim them *urbi et orbi.*"

A more sensible criticism on the publications of the laboratory is that they are made in such a way as to create unnecessary alarm, and give a wrong idea of the amount of danger. From the figures given it is natural for a Parisian to conclude that he has only one chance in ten of getting a good wine, three chances in ten of getting good milk, &c. But it must be remembered that almost every sample analyzed is suspicious. To draw conclusions from the results of these analyses as to the character of the whole supply is like saying "ten persons out of every hundred tried for theft are acquitted—therefore of every hundred Parisians ninety are thieves."

If the samples were collected indiscriminately, the proportion of adulteration indicated would be enormous; but such is not the case. M. Cochin proceeds to criticise the standards adopted at the laboratory for wine and milk analysis, objecting that they are too high, and thinks that there should be a sort of court of appeal from its decisions, somewhat as is arranged in England. Space is, however, wanting for a further account of this paper here, and we can only commend its perusal to those who are specially interested in its subject.—*Sanitary Engineer.*

THE ANALYST

DECEMBER, 1883.

SOCIETY OF PUBLIC ANALYSTS.

A GENERAL MEETING of the Society was held on Friday Evening, the 16th November, at Burlington House, Piccadilly, the President, Mr. Wigner, in the Chair.

The minutes of the previous meeting were read and confirmed.

The following gentlemen were proposed for election:

As Member, Mr. O. Wilkinson, F.C.S., Public Analyst for Stockport, as Associate, Mr. C. Roberts, Assistant to Mr. W. Fox, of Trinity Square, London.

The following papers were read·

"Note on Selenium," by Dr. Drinkwater.

"On a Recent Whiskey Prosecution," by Dr. Angell.

"On Milk Adulteration in London," by Mr. Wigner.

"On Milk Analysis," by Mr. Estcourt, Dr. Duprè, Mr. Hehner, and Mr. Allen.

A long discussion ensued.

Our space will only permit us to print these papers in this issue; the notes of the discussion will appear in our next number.

ADDITIONAL NOTE ON THE PRESENCE OF SELENIUM IN SULPHURIC ACID, AND ITS INFLUENCE ON REINSCH'S TEST.

BY DR. DRINKWATER, F.C.S., LECTURER ON CHEMISTRY, EDINBURGH SCHOOL OF MEDICINE.

SINCE the publication of my paper on Selenium in Sulphuric Acid, read before the Society in March last, I have been conducting further experiments. One set of results are interesting from a medico-legal stand-point.

On distilling sodic chloride with the selenised acid, as in the manufacture of hydrochloric acid, I found that all the selenium distilled over and was dissolved in the acid, the saline residue being practically free from the impurity.

The results were independent of either temperature or quantity of acid employed. I made experiments leaving both acid and normal salts as the bye products, and in every case the residues were free from selenium; the method employed in testing being to boil up the residue with hydrochloric acid, and pass in sulphurous acid gas, as described in my previous paper.

The sulphuric acid employed was not the artificially selenised acid but some of the original sample, No. 2, which it may be remembered contained ·38 grammes in 100 c.c.

On boiling a piece of pure copper foil with the impure hydrochloric acid made as described, a deposit was obtained which resembled in all outward appearance the arsenical deposit obtained in a similar manner in Reinsch's test. On heating this in a dry test tube, a sublimate was collected of a distinct crystalline structure, which differed however from an arsenical deposit both in the shape of the crystal and in its colour. The sublimate dissolved in concentrated sulphuric acid with the characteristic greenish-brown colour, and was precipated in red flakes on the addition of water.

Remembering that selenium is not such an uncommon impurity in sulphuric acid, and seeing the ease with which it is transferred to the hydrochloric acid, it becomes an important factor in using Reinsch's process for medico-legal purposes.

NOTE ON A CASE OF TRANSPOSITION OF SAMPLES.

By A. Angell.

A sample of whiskey examined by me in August last was found to be ·9513 sp. gr. = 28·85 u.p. I therefore certified that it was adulterated with water.

The case was heard at the Droxford Petty Sessions, and was adjourned in order that the third part of the sample might be sent to Somerset House. A report of the adjourned meeting and magistrate's decision taken from a Portsmouth paper will appear in our journal.

The whiskey was examined by Dr. Bell, who found it to be 8·7 u.p., also by Mr. Sidney Harvey, who declared 9·2 u.p. Upon this evidence the case was dismissed, costs allowed, and the police were directed to have the attention of the proper authorities called to the great discrepancy in the analyses.

I now find on reference to my book that no other sample of whiskey was passing through my laboratory at the time this one was examined, and that two weighings were made upon separate balances, and with separate sets of weights, with identical results and, further, that a part of the sample was put by for reference if needed. This precaution I take with all adulterated samples.

No notice was given to me at any part of these proceedings, and I heard nothing of the case until the day after its final dismissal, and then only indirectly through a friend who happened to be in court. No solicitor was engaged, and the only counsel for the prosecution was a police officer. There being no one present to support my certificate, or to point out the great improbability of the sale to the public by a small country roadside innkeeper of spirits at 8·7 u.p., and no chance of producing corroborative evidence, my figures were taken as erroneous; and the gross carelessness and want of qualification on the part of the Public Analyst was strongly commented upon, both by the counsel for the defence, and by the chairman of the court.

Immediately upon being informed of what had happened, I referred to my part of the sample and again found it 28·85 u.p. I then sent on the sample to Mr. Hehner, and he forwarded it to Dr. Dupré. The certificates of these gentlemen are as follows:

Mr. Hehner	28·42 u.p.
Dr. Dupré	29·40 „

My object in bringing this case before the notice of the Society of Public Analysts is to point out the unfairness of dismissing disputed cases without hearing the evidence of the Public Analyst, and to take the opportunity of remarking upon the want of uniformity of method in purchasing samples, the great number of officers employed as collectors in county districts, and believe the entire absence of any attempt to obtain the articles as supplied to the public.

The certificate of the Public Analyst is evidence. This, in my opinion, is somewhat unfortunate, for it is not always all the evidence which that official can produce. It is evident that at the time the certificate is drawn up it is not known that a defence will be set up, nor of what kind of evidence that defence will consist. So that it is impossible to so word a certificate as to make it in all cases the best evidence to be got; and, if I understand aright, one of the fundamental principles of English law is that the best evidence available shall be obtained.

In this case it would have been an easy matter to have shewn to the magistrates that the whiskey sent to Somerset House could not have been the same as that examined by Mr. Hehner, Dr. Dupré, and myself; consequently certain remarks from the Bench would not have been made.

With regard to the administration of the act, I submit that there is great room for improvement. The working of the act is well understood; adulteration in most articles fairly well defined; methods of analysis pretty uniform and generally adopted by Public Analysts. So far, therefore, as the analysis is concerned, there is no likelihood in the future of any frequent difference of opinion or in results, and that part of the administration of the act, which constitutes the duties of the Public Analyst, is now being worked with confidence and reliability. It is in the mode of collecting samples and in the number collected that more care and uniformity is needed.

In some counties the officers of the police force are employed as collectors, no extra pay being allowed for the duty, which is naturally irksome.

Samples are purchased generally by the officers in their respective districts, and in uniform, and being well known it is very unlikely that adulterated goods will be supplied to them.

In several districts a Public Analyst has been appointed for years, but no collector, consequently no samples are submitted for analysis; this is especially the case in small boroughs where trade interest is strong upon the Council, these bodies are therefore interested in smothering the operation of the act. The boroughs are often located in country districts in which the act is applied. The shopkeeper carrying on trade within the limit of the borough has a decided advantage over one just outside who has to sell his goods subject to the provisions of the act.

I know one town in Hampshire where the milk carried in is watered with impunity as soon as the cart has passed the city boundary.

It would, I think, be well if this meeting were to organize an enquiry with a view of collecting data, shewing these abnormal conditions, and where they occur, with a view of doing something towards rendering the working of the Sale of Food and Drugs Act more uniform, more regular, more reliable, and therefore more efficient throughout the Kingdom.

THE MILK SUPPLY OF LONDON.

By G. W. Wigner, F.C.S., F.I.C., President of the Society of Public Analysts.

Read before the Society of Public Analysts, November 16th, 1883.

Pure milk appears to be the exception rather than the rule in London, though, perhaps, London is not worse off in this respect than some of the other large cities, but it has been my conviction for a long time that the regular reports which we, as Public Analysts, make, give very little idea of what the actual extent of milk adulteration is. Inspectors, are, of course, always recognised by those who make adulteration a business. The regular adulterators are seldom convicted.

It is very important, however, in the public interest to know how far milk adulteration actually prevails, and at some considerable trouble I have endeavoured to find out what the quality of the average milk supply of London really is. Londoners within the area of the London Water Companies supplies number nearly, or quite, four and three quarter millions, say 4,760,000 and the cost of the milk supply is therefore a tolerably large figure.

The limit of pure milk has by almost (but not quite) universal consent been fixed at 9·00 per cent. solids (not fat), and 2·50 per cent. fat. My opinion is that this is if anything too low, especially in fat; so I procured 55 samples during the month of October from entire dairies of milk as the milk arrived in London. The farmers' men may have added a little water, but, unless in one case, I have no reason to think that this has been done. No precautions whatever were taken to procure special samples, so I am fairly justified in saying that this milk is a fair sample of what dairy farmers can supply in London during the month of October. These deliveries are from the milk of about 2,000 cows.

Out of this series of 55 samples, the solids (not fat) fell in one case to 8·93 per cent., with 3·14 per cent. of fat, and in the next lowest case to 9·10 solids (not fat); that is 54 out of 55 samples are above the limit, and the one remaining sample has a high proportion of fat, but the average is more important, and this comes to solids (not fat) 9·60, fat 3·46, total solids, 13·06, so that the average of these 2,000 cows is at the very least six per cent. above the limits used by the Society, and nearly 40 per cent. higher in fat.

So much for what comes to London: now let us see what is sold in London.

It is proper to expect that *some* of the best milk should be delivered, for however leniently a milk seller may generally look upon watering, we cannot expect that all of them do so.

I purchased 300 samples in London, and three out of the 300 corresponded with the average of the milks sent to London, and one of the 300 was richer than the average; 296 remain to be accounted for, 93 of these pass the limit. They may have been watered, and, in fact, many probably have, but they are just above the limit; 203 or 67·9 per cent. are below the limit, and this represents the amount of sophistication I have actually found. The percentage of added water in these samples varies from 3 per cent. to 61 per cent.

Out of the 300 samples no less than 60, or 20 per cent. of the total, are just on the limit line of solids (not fat), and fat in genuine milk.

But as soon as this limit line is passed, watering goes on rapidly; 15 per cent. of the samples contain more than 20 and less than 30 per cent. of added water, and 15 per cent. contain more than 30 per cent., in all 68 per cent. were watered.

The percentage of skimming is almost equally formidable; here again I have passed all samples above the limit, though it is too low; but even on this low calculation 19 per cent. were skimmed as well as watered, and more than 7 per cent. were skimmed but not watered.

This tale of sophistication is really serious to the public. Averaging the 300 samples, the average result is that 13 per cent. of the fat has been skimmed off, and that the milk has, in addition, been watered nearly 13 per cent.; while if the figures I actually found in the dairies are taken as the standard, as I consider they ought to be, 20 per cent. of the fat has been skimmed off, and the watering is 19 per cent.

Ten years working of the anti-Adulteration Acts has brought us really to this point, that as regards milk our position is hopeless until the law is amended; no one can hope to get pure milk in London, unless under other guarantees than this Act affords, and we ought to tell the public so that they may take action in the matter.

Trivial fines of a few shillings do not bear on the question at all. The average consumption of milk in the middle class districts of London may be taken at something like 10 gallons per head per year, but to put it at the least I will take 3¼ gallons per head per year as the average, or say 1½ oz. per day each person. The milk bill of this population of 4¾ millions must therefore be, at 5d. per quart, somewhat about £1,400,000, or seven-eighths of the water rates, which are £1,562,000.

This milk appears to be watered on the average nearly 19 per cent. The value of this milk replaced by water is £266,000 per year. It is not easy to say absolutely what value shall be given to the fat, but certainly it is putting the most lenient view possible on the matter if we consider that the abstraction of this fat is equal to a value of £90,000 more.

Adding this figure to the other, I find that we in London pay £356,000 a year for fraudulent dealing with milk—just about one-fifth part of our water rates. How long this will be tolerated I cannot say, but it needs no calculation to show that the amount is enough to pay a profit to all the vendors concerned, if only it were fairly divided.

VALUATION OF MILK SOLIDS INSTEAD OF A LIMIT OR STANDARD.

By C. Estcourt.

At the important appeal case decided in Manchester, on 5th October last, a mass of scientific evidence was given upon the question of milk adulteration and milk analysis by many of the most competent analysts in the kingdom. Probably no better representative meeting of analysts competent to deal with the question could be gathered together. The Society of Public Analysts, the Somerset House Laboratory, and the Laboratory of the Royal Agricultural Society were represented. The only drawback to the value of this meeting was that it took place in a court of justice, and that the scientific witnesses were therefore only permitted to tell the truth so far as they were allowed to give evidence, but were not permitted to tell the whole truth, as is patent to all who have given evidence in courts of law. It is impossible for any ordinary judge to decide upon so important a matter with such meagre information as is permitted to be supplied by scientific witnesses. If however, such a gathering could come together again, with such important additions from the three bodies named as might be made, the whole question might be set at rest for ever. To do this with due consideration for the consumers of milk, the producers of milk, and the analysts themselves, two points must be agreed upon, namely: What shall be the inferior limit of the two important constituents of milk; and what is the most perfect and practicable process for estimating those constituents.

To aid in arriving at the desired result, I have made a large series of calculations based upon the limit of the lowest non-fat solids yielded by a dairy of cows. This is given by

Somerset House, and Dr. Cameron, Mr. Hehner, Dr. Vieth, and Mr. B. Dyer, as 8·5, and the lowest amount of fat in genuine milk, Dr. Voelcker (the representative of the producers' interest) has fixed at 3·0.

To each of these constituents I would attach a fixed value, to be agreed upon.

In all my calculations, no valuation appears to cover so large a number of possibilities as the one I venture to suggest.

Of non-fat solids 8·5 per cent. shall equal	200
Of fat solids 3·0 per cent.	100

Factors deduced from these figures are—

Non-fat factor	7·85
Fat factor	11·10

I propose that a milk which contains such a percentage of non-fat solids and fat solids as multiplied by their respective factors will together produce 100 shall be considered milk of full value.

Thus for example, a milk which yields—

8·5 per cent. not fat, and
3·0 per cent. fat, will yield

One hundred parts of milk

$$8{\cdot}5 \times 7{\cdot}85 = 66{\cdot}72$$
$$3{\cdot}0 \times 11{\cdot}10 = 33{\cdot}30$$
$$100{\cdot}02$$

The following table will show how great a range in the composition of milk will be covered by this valuation.

Non-fat.	Fat.	equal	Parts of Milk.
8·0	3·35		99·98
8·1	3·28		99·99
8·2	3·21		100·00
8·3	3·14		100
8·4	3·07		100
8·5	3 00		100
9·0	2·65		100

Extreme examples of watering or skimming show that the fat or the non-fat solids respectively must be high—thus the consumer receives full value.

	Non-fat.	Fat.		Parts of Milk.
Watering	6·0	4·76	=	99·93
Skimming	10·0	1·94	=	100·03

NOTE.—*Rule* : For each 0·1 solids not fat below 8·5 there must be an increase on fat of 0·07.

Valuation as proposed, applied to Dr. Bell's table of single cow's milks.

Not fat.	Fat.	Per cent. of Milk.
8·77	2·65	97·90
8·60	2·67	97·19
8·95	2 25	95·25
8·33	2·95	98·16
8 98	2·29	95·98
8·59	2·26	93·20
8·00	2·31	88·46
8 54	2·78	97·92
8 86	2·31	95·20
8·66	2·19	92·31
8 59	2·83	98·87
8·01	2·42	89·76
8·66	2 77	98·75
9·07	1·92	92·53
8·77	2·65	97·77
8·39	2·97	98·85
8·66	2·27	93·2

This method, which I have carefully worked out, will, I find, meet all the views of the three bodies I have named.

In Dr. Bell's tables of analyses of single cow's milks, which are all of somewhat doubtful genuineness, only 17 are found to be condemned by this valuation.

The following analyses of genuine milks, authenticated either by myself or the Manchester Inspectors, will serve to show the variation in farm milk.

ANALYSES OF GENUINE MILKS.

Samples of Milk from cows milked in the presence of myself and Inspectors of the Corporation of Manchester.

Date.	Time.	No. of Cows.	Solids not Fat.	Fat.	Total Solids.	How Fed.
July …… 9	2.30 to 3.0 p.m.	4	9·34	3·46	12·80	Grass
,, …… 9	2.30 to 3.0 ,,	8	9·17	3·38	12·55	,,
,, …… 9	5.0 p.m.	4	9·34	3·74	13·08	,,
,, …… 9	5.0 ,,	3	9·61	3·20	12·81	,,
,, …… 31	1.0 ,,	6	9·04	3·44	12·48	,,
,, …… 31	1.0 ,,	5	9·03	3·71	12·74	,,
,, …… 31	1.0 ,,	10	9·01	3·92	12·93	,,
,, …… 31	1.0 ,,	11	9·18	4·27	13·45	,,
,, …… 31	1.0 ,,	32	9·10	3·98	13·08	,,
,, …… 31	4.30 a.m.	32	9·07	2·89	11·96	,,
August …. 6	6.0 ,,	6	9.47	2·68	12·15	,,
July …… 9	5.0 ,,	1	10·52	3·33	13·85	,,
Total, 12 dairies or shippons……		122.	Dairy avge. 9·32	3·50	12·82	
July …… 13	3.0 p.m.	9	9·32	3·81	13·13	Stall.
,, …… 13	3.0 ,,	10	9·44	3·82	13·26	,,
,, …… 13	3.0 ,,	16	9·28	4·36	13·64	,,
,, …… 13	3.0 ,,	15	9·10	4·46	13·56	,,
,, …… 13	3.0 ,,	1	9·16	4·11	13·27	,,
Total, 5 dairies or shippons ……..		51	Dairy avge. 9·26	4·11	13·37	

Samples of Milk from cows milked in the presence of two or more Inspectors of the Corporation.

Date.	Time.	No. of Cows.	Solids not Fat.	Fat.	Total Solids.	How Fed.
May …… 25		14	10·04	2·83	12·87	Grass.
June …… 1		11	9·39	3·26	12·66	,,
Total, 2 dairies ……………….		25	Dairy avge. 9·71	3·04	12·76	
July …… 17	4.15 to 6.30 a.m.	9	9·69	2·50	12·19	Stall.
,, …… 17	4.15 ,, 6.30 ,,	10	9·92	2·60	12·52	,,
,, …… 17	4.15 ,, 6.30 ,,	16	9·71	2·61	12 32	,,
,, …… 17	4.15 ,, 6.30 ,,	15	9·50	3·06	12·56	,,
Total, 4 shippons …. …………		50	Dairy avge. 9·70	2·69	12·39	

These milks are from dairies in Lancashire, Cheshire, and Derbyshire.

In Dr. Voelcker's examples of cows producing what he calls even poor milk (excepting of course the Cirencester half-starved cows) none would be below the valuation.

In the samples reported upon as adulterated (during a period of nine months in the City of Manchester) out of 340 milks, 82 were returned as adulterated, and of these latter only four would pass this valuation, and all four were fairly high in fat.

It would meet the Public Analysts' views, inasmuch as in the event of it being decided to use such a process of analysis as has been suggested by Messrs. Hehner, Dyer, and many others, the solids not fat would be found as low as 8·5, and the fat correspondingly increased. To the honest farmer it would undeniably be a great boon. It would give those, who by careful choice of breed, and by good feeding produce richer milk than their competitors, a reward in increased prices. Their milk would command a better price from milk dealers who by purchasing and mixing with it the poorer milks (which come into the market at a correspondingly low price) would be enabled to produce a milk of uniform value. To the public, it would thus secure a milk of more uniform value. If the non-fatty solids were low, the fat must be correspondingly increased, so that instead of the present chance method of buying a poor milk at the same price as a rich one, the public would secure one which would have its proportional value present of solids not fat and fat. This would also put a stop to the necessity on the part of the producers of risking the watering of a rich milk, as a portion of the cream might be taken off, enabling the more skilful farmer to compete with the less rich milk, without running the chance, as he now does, of being stigmatised as dishonest. In brief, I see no reason why the farmers, like the dealers in *manufactured* products, should not derive all the advantages their superior skill and care give them in producing milk above the average. With the agreement of the three bodies named to some such valuation, the whole of the difficulties of the milk question will disappear, as the method to be adopted can be settled by actual analysis of portions of the same milk by different representative analysts.

For this purpose I would suggest that the Public Analysts' Society choose six gentlemen from that body; the Somerset House, two gentlemen; that Dr. Voelcker and another representative act for the Agricultural Societies, and for the producers.

The following are the processes I would suggest:

The Wanklyn process as devised by Wanklyn (see his book). This process as modified by several analysts, namely:—with petroleum ether instead of ether, and with decantation instead of filtration, and weighing the non-fatty solids instead of the fatty.

The Somerset House process, with the exception of the pasty drying before ether.

The total solids and the specific gravity method, by which the fat is calculated from these two data.

In all these methods the time of drying with all other details should be laid down in the instructions to the chemists engaged. The process which produces uniformly the highest amount of real fat to be selected. It would then only require a short Act of Parliament defining the method of valuation and the process of analysis as agreed upon, and if we agree to some such scheme as I have suggested, the legislature will, I feel sure, place no obstacles in the way of settling so long vexed a question.

Note.—Skim milk should contain not less than 9 per cent. total solids or its equivalent calculated as

8·5 per cent. not fat × 7·85 = 66 72
0·5 per cent. fat × 11·1 = 5·55

Valuation of skim milk = 72·27

ON SOME POINTS CONNECTED WITH MILK ANALYSIS.

By A. Dupré, Ph.D., F.R.S.

The recent Manchester milk case has shown in a striking manner the difficulties still surrounding the question of milk analysis, and will no doubt necessitate a careful reconsideration, by the Society of Public Analysts, of all points relating to it.

Before, however, entering on the consideration of any of the chemical questions involved, I wish shortly to comment on two statements, which have been advanced on behalf of Somerset House. Firstly, the statement that Somerset House "is perfectly neutral as between the parties," has been put forward in a manner to imply that Public Analysts are not neutral. Whether this was the meaning intended to be conveyed I know not, but it is the natural inference to be drawn from the statement as made. Be this as it may, I wish to enter my emphatic protest against such a statement, which in my opinion is one that ought not to have been made. Public Analysts have nothing to do with one party, or the other, and are absolutely neutral.

In the second place, the Somerset House Chemists seem to imagine that they only, in deciding on the genuineness, or otherwise, of any given sample of milk, take into consideration the whole of the constituents of the milk, by which statement, I presume, is really meant the fat, solids not fat, and ash. Now it has been stated over and over again at our meetings, that in order to come to a correct and just conclusion it is not enough to take into consideration the solids not fat only. Indeed the necessity of doing this is so plain that it seems incredible that anybody should think otherwise. The statement is entirely erroneous.

Method of Analysis to be adopted.—It appears to be imagined by some that that process for estimating the proportion of solids in milk which gives the lower result is necessarily the correct one. The fallacy of such reasoning is sufficiently obvious to an analytical chemist, but when made before non-scientific persons it is very apt to mislead them. It is probably impossible to estimate with any extreme degree of exactness, the amount of solids contained in a fluid of such complicated composition as milk, and all our processes will give approximations merely, that process being the best which gives the most constant or concordant results; whether the result is slightly higher or lower than that given by other processes is perfectly immaterial.

Drying to constant weight.—Some chemists profess to dry their milk residues to constant weight and apparently pride themselves on their superior accuracy. I never attempt to do this and I have no doubt that nobody else does it. What is really done probably is to dry the residue to such a degree that it shall not lose more than say one milligram, or 1/100th of a grain in an hour or so; this much can readily be accomplished and is all that is necessary. To attempt to dry to absolute constancy would not only require much time, even if it could be accomplished at all, but would be of very doubtful advantage. At any rate it would be well if every one who says that he dries his milk residues to constant weight were to give exact details as to what he really does, and the question of drying to constant weight or not could then be fairly discussed.

Influence on composition or specific gravity.—Hitherto it has been supposed that the specific gravity of milk was governed mainly by the percentage of fat and of solids not fat it contained. If, however, the tables in Dr. Bell's little work, *Analysis and Adulteration of Foods*, giving the composition of a number of samples of milk, are correct, a main cause of variation must be sought for in the varying composition of the solids not fat.

The chief non-fatty solids of milk are sugar, casein and albumen, and ash, and any variation in the influence exerted by equal percentages of these solids must obviously be brought about by a variation in the relative proportion of these main constituents. It becomes therefore of importance to determine—firstly, the influence on gravity due to each of these constituents; and secondly, the extreme variation in the proportion of each found in genuine milk from healthy cows. In order to throw some light on the first point, I have had several samples of milk carefully examined in regard to the following points. Specific gravity of entire milk, total solids, fat, solids not fat, ash, specific gravity of the whey obtained by coagulating the milk at a boiling temperature after the addition of some acetic acid, the amount of solids contained in this whey, both organic and inorganic. I have taken all organic solids not fat coagulated by the above process as casein and albumen, and all the organic solids in the whey as sugar. This is no doubt not quite correct, as there are other substances present in small quantity, but the error, if any, thus introduced cannot be large, and in ordinary milk analysis no further separation into constituents would be attempted.

Taking then the influence on gravity of 1 per cent. of fat, according to O. Hehner, at —0·75,* I find the influence of 1 per cent. solids not fat to be + 3·624 of 1 per cent. of sugar, + 3·70 of 1 per cent. of casein and albumen + 2·55. The factor for solids not fat is practically identical with that previously found by O. Hehner.

The specific gravity of an average sample of milk will therefore be made up as follows:

Constituents.		Influence of these on gravity.
Fat	3·5 per cent.	— 2·54
Sugar	5·0 „	+18·50
Casein, &c.	3·3 „	+ 8·42
Ash	0·72 „	+ 5·40

Specific gravity of milk ...... 1029·78
Specific gravity without the fat 1032·32

Supposing in this milk the organic solids not fat to be either all sugar or all casein and albumen, the alteration in gravity thereby produced would be the maximum possible which could be produced by any variation in the relative proportion of these constituents. The proportion of ash varies so slightly in all genuine milks that its influence on gravity may be taken as an almost constant quantity.

Well then, the specific gravity of the above milk with all sugar would be 1033·50
with all casein and albumen 1023·95

difference 9·55

Such milks are, of course, never found; nethertheless, the figures show that no inconsiderable variation in the gravity of milks, with the same percentages of solids not fat, might be found, particularly when dealing with milks from single cows. In mixed milks from a number of cows variations in gravity due to this cause will probably always be small.

A variation for example from 2·5 per cent. casein and albumen, and 5·8 per cent. of sugar, to 4·3 per cent. of casein and albumen, and 4·0 per cent. of sugar, would produce a difference in gravity of 2·07 only. In Dr. Bell's tables, variations amounting to 8·77, after allowance for fat and ash has been made, will be found.

It is obvious that when these specific gravity factors have once been accurately fixed —and I bring forward my factors as first approximations only, we should be able to calculate the composition of a milk in considerable detail from the figures usually obtained in any ordinary milk analysis, viz.: the specific gravity of the milk, fat, solids not fat, and ash.

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* According to my experiments 1 per cent. of tribasic phosphate of calcium has an influence on gravity of 7·6; the other ash constituents have slightly less.

Thus we get the specific gravity due to the sugar, and casein, and albumen, by adding to the specific gravity of the milk the loss in gravity due to the fat, and subtracting that due to the ash from the remainder, and from the above specific gravity factors, we may calculate the amounts of sugar, and casein, and albumen, as follows. Let x represent the amount of sugar; y, that of casein, &c.; a, the total amount of sugar and casein, &c. (solids not fat minus the ash); and b, the gravity due to these calculated as above. Then

$$x + y = a$$

$$3{\cdot}7\,x + 2{\cdot}55\,y = b$$

$$x = \frac{b - 2{\cdot}55\,a}{1{\cdot}15}$$

$$y = a - x$$

To give an example. I found the specific gravity of a milk to be 1030·5, and this milk contained fat 3·51, solids not fat 9·19, ash 0·72. We have therefore, $a = 8{\cdot}47$ and $b =$

$$\begin{array}{rr} & 30{\cdot}50 \\ + \; 3{\cdot}51 \times {\cdot}725 = & 2{\cdot}53 \\ - \; {\cdot}72 \times 7{\cdot}5 = & 5{\cdot}40 \\ \hline & 27{\cdot}64 \end{array}$$

From which we calculate, $x = 5{\cdot}25$, and $y = 3{\cdot}22$. The proportion of sugar and casein, &c., found by actual analysis having been 5·38 and 3·09 respectively. I believe it will be found that such a calculation will give a useful check as to the accuracy or otherwise of the results obtained in milk analysis.

As above stated, I bring forward these specific gravity factors as first approximations only, my object in this paper being mainly to illustrate to what extent the specific gravity of a milk may reasonably be expected to vary, owing to varying proportion of sugar and casein, &c.; and secondly, to point out the value of some factors, when once carefully ascertained, in general milk analysis.

I have indeed found that my factors are totally inapplicable to the analysis of cows' milk, given on page 3, part II., of Dr. Bell's little work. Nor have I been able to calculate any factors embracing all five analyses given. Factors however can be calculated which will give, with a fair degree of accuracy, the composition of milks, No. 1, No. 2, No. 3 and No. 5. These are—factor for 1 per cent. of sugar 4; for 1 per cent. of casein, &c., 2·7. Applying these to milk No. 1, for example, we get

	Found.	Calculated.
Sugar	4·91	4·95
Casein, &c.	3·05	3·01

Applying these latter factors, in conjunction with those for fat and ash previously given, to Dr. Bell's larger tables of milk analyses, some strange results are obtained. I will give four only, which, however, it is only fair to add, represent, I believe, the extreme cases.

Milk from single cows:—

No. 33, page 20,	Sugar	6·58	8·92
	Casein, &c.	2·34	
No. 9, page 25,	Sugar	0·91	10·40
	Casein, &c.	9·49	

Similar differences, though not quite so striking, are found even among the Dairy samples.

No. 5, page 26, Sugar	5·34	7·98
Caseine, &c.	2·64	
No. 16, page 26, Sugar	2·22	9·15
Caseine, &c.	6 93	

I cannot help thinking that there is something wrong in these analyses.

I have, I trust, said sufficient to show the value of the factors proposed when once fairly established, and also to induce others to take up this inquiry, which is one of very considerable interest in relation to milk analysis, and which, at the present time, urgently requires examination.

Loss of Solids on Keeping.—This question has been repeatedly investigated by members of the Society of Public Analysts; first, I believe, by Dr. Stevenson, in a paper read before the Society, February 5th, 1875. The general conclusion arrived at was that when once the milk had suffered changes other than merely turning sour, correct analysis was no longer possible. At Somerset House they seem, however, to have arrived at a different conclusion, and a correction for "natural loss" figures in all certificates issued from Somerset House relating to the analysis for old milk, as if this loss was a regular, and naturally regular, thing which could be calculated with nicety. I have, therefore, once more undertaken some experiments on this question—which is one of very considerable importance, and trust that others will also give their more recent experience; we may then hope to dispose once for all of this imaginary regular natural loss.

No. 1 was a sample of milk which came to me for analysis, and had accidentally been left standing in the laboratory in the half empty bottle; no care whatever had been taken for its preservation.

Nos. 2 and 3 was a sample of milk purchased by myself, the only difference between them being that in the case of No. 2 the bottle had been filled completely, while in the case of No. 3 the bottle was only three-fourths filled. Great care had been taken to clean the bottles. These three samples were analysed the second time twenty days after the analysis of the fresh milk. The remaining four samples were samples retained by the Inspector, and would have been forwarded to Somerset House for analysis had there been occasion for it. The bottles were nearly full, and the second analyses were made twenty-five days after the first.

Number of solids not fat:—

Sample.	Originally.	After keeping.	Calculated by Dr. Bell's figures.	Difference.	Acid as lactic acid.
1	8·27	8·21	8 60	+ ·33	1·05%
2	9·21	8·70	9 09	— ·12	1·18%
3	9·21	8 42	8 81	— ·40	1·06%
4	8·08	7·84	8·29	+ ·21	1·12%
5	8·83	8.30	3·75	— ·08	1·06%
6	8 66	8 20	8 65	— ·01	1·19%
7	7·68	7·20	7 65	— ·03	1·12%

Every figure given is the mean of two concordant analyses, and all samples, except No. 1, which stood during September, were examined twice during the month of October.

It will be seen that in two cases the calculated result agrees closely with the original analyses, in two more the agreement is moderately close, while in the remaining three it is very wide of the mark. It is to be noted, more especially, that in two cases, the calculated result is considerably higher than the original analysis, these milks most unnaturally not having suffered their fair share of "natural" loss, whereas in the one remaining case, No. 3, the actual loss far exceeded the "natural" loss. The difference between Nos. 2 and 3, the same sample bottled at the same time, is also very striking. The last column of this table gives the percentage of acid, calculated as lactic acid contained in the milk at the time of the second analysis. As was to be anticipated, there is no connection between actual loss and degree of acidity, notwithstanding the statement to the contrary advanced by Dr. Bell.

These results, confirming as they do results previously obtained by other observers, are, I think, sufficient to prove that no allowance for so called "natural" loss can be made after a milk has been kept for some time. The only safe and true course for an analyst to pursue when he is asked to analyse an old sample is to declare his inability to give an opinion as to its purity or otherwise, except in cases in which the watering has been so considerable that no observed variation in the rate of loss could account for the results found, or in cases in which the ash is lowered sufficiently to afford a safe ground to form an opinion.

In conclusion, I would express a hope that Dr. Bell has been incorrectly reported, when he is made to say at Manchester that the method on which the so-called natural loss for milk is calculated is perfectly scientific, and similar to that on the strength of which his Board pays a drawback of over half a million a year in the case of beer. The method is not scientific, and there is no analogy whatever between the two cases mentioned.

NOTES ON MILK ANALYSIS.

By Otto Hehner, F.C.S., F.I.C.

Read before the Society of Public Analysts, on November 16th, 1883.

I have, on a former occasion, expressed my strong conviction that the different conclusions arrived at by different observers, as to lowest limit of solids not fat to be found in natural milk, were mainly due to the difference between the various methods of analysis adopted. I have shown that, by drying to practical dryness—that is to say, till the solids lost no more than one milligramme when heated in a water-over for one hour, and by a more effective mode of fat extraction—namely, by treating the dry total solids in a Soxhlet tube with ether, for one to two hours, results could be obtained which were from ·4 to ·6 per cent. less than those yielded by the plan advocated by Mr. Wanklyn. In the great majority of published instances of samples of milk which have yielded less than 9 per cent. of solids not fat, the deficiency is less than ·6 per cent.; and I hold, therefore, that neither "bamboozling" of inspectors nor incapacity of analysts need be assumed, when such differences do occur. I feel convinced that they will disappear as soon as a satisfactory and uniform method of analysis is universally adopted.

In the Wanklyn method of analysis requirements which should be expected of a trustworthy analytical method are wanting. What would we say of any method proposed in ordinary analysis, in which not only no precaution was taken to obtain a weighable product of known composition, but in which an admittedly moist precipitate was weighed; would we tolerate a method which required the admittedly imperfect extraction of one of the main factors of the enquiry? Yet, in milk analysis, the residue was neither required to be dry, nor the fat extracted as completely as possible.

In the older days of milk analysis, when the object of the analysis was generally to find out large percentages of added water, a crude method led to no very serious conflict; but in these days of refined milk-blending, when the analyst has no longer to deal with units of solids not fat, but with tenths of units, a more scientific method is imperatively demanded.

The efforts of Public Analysts should be directed to that purpose, and believing, that every fact, however small, which bears on the question, will prove useful in guiding towards a proper judgment, I venture to bring before the Society the following somewhat disjointed observations.

1. *Solubility of milk sugar in ether.*--Pure, dry, crystallised milk sugar was shaken for some days in stoppered bottles, with (*a*) anhydrous ether, (*b*) commercial ether, (*c*) ether containing 10 per cent. of alcohol, and (*d*) ether saturated with water, and containing some undissolved water, so as to render the milk sugar wet.

From 100 c.c. of each ethereal fluid the following quantities of dissolved milk sugar were obtained :—

(*a*)	nil.
(*b*)	nil.
(*c*)	·0002 grms.
(*d*)	·0009 grms.

Under no conditions, therefore, is milk sugar appreciably soluble in ether, be the latter pure or charged with water or alcohol. The objections raised on this head, against the process adopted by the Somerset House Analysts, therefore falls to the ground.

2. *Condition of milk sugar in the milk residue.*—600 grms. of chemically pure dry crystallized milk sugar were dissolved in water at 60° F. to 100 c.c. The specific gravity of the solution was 1022·25. Hence 100 grms. of the solution contained 5·8694 grms. of crystallised milk sugar, or 5·58 grms. of anhydrous milk sugar.

Of this solution separate portions were weighed into milk dishes and evaporated.

5·1014 grms. furnished, after three hours, drying in Mr. Wanklyn's pressure vessel, (a water-oven showing 206° F.) ·3279 or 6·38 per cent. of residue. This, dried over night in the oven, fell to ·2846 grms., or 5·58 per cent.; that is to say, whilst after three hours drying the residue still contained ·51 per cent. of moisture, after 12 hours it had become *anhydrous* milk sugar.

6·3414 grms. of the solution, evaporated on the open bath, and the residue dried for three hours in a water oven, yielded ·4224 grms., or 6·66 per cent. of residue. This was further dried in the water-oven and weighed every hour, with the following results :—

Hours.	Weight.	Percentage.
4	·4079	6·43
5	·3954	6·24
6	·3788	5·94
7	·3668	5·79
8	·3550	5·59
9	·3550	5·59

After about 6½ hours the residue possessed the weight of the amount of milk sugar taken; after eight hours it was anhydrous. The residue diminished in a fairly even ratio, and at no point was there any indication that the loss was no longer due to mechanical moisture, but to hydratic water.

5·6993 grms. of the solution referred to were evaporated in a milk dish, and kept on the *open* water bath. The following are the results:—

Hours.		Weight.		Percentage.
2½	....	·3402	....	5·79
3½	....	·3232	....	5·67
4½	....	·3194	....	5·61
5	....	·3192	....	5·60

Here again, the dry product is *anhydrous* milk sugar, but the drying proceeded much more rapidly on the open than in the closed bath, a result agreeing with that arrived at by me on former occasions (*vide* ANALYST, Vol. VII. p. 60).

The fact that under no conditions of milk analysis hydrated milk sugar can at will be obtained, strongly points in favour of drying the residues to constant weight. It entirely disposes of, and demolishes the distinction drawn at the recent Manchester case between methods by which crystallised, and others by which anhydrous sugar is the result. The experiments also contradict the possibility of employing any other criterion of dryness than constancy of weight, all time limits being illusory and accidental.

The observations as to the anhydrous state of milk sugar in milk residues bear out the statements of Erdmann (*Berl. Ber.* 13, p. 2180), who obtained anhydrous milk sugar by rapidly boiling down a solution of ordinary milk sugar in a metal vessel.

Seeing the readiness with which lactose loses by evaporation of its solution its 5 per cent. of hydratic water, I expected that dry crystallised milk sugar would also easily part with the same, but was much surprised in obtaining from 5·4933 grms. of pure lactose, but ·0056 grm., or ·12 per cent. of water, when dried over night at 206° F.

3. *Influence of milk sugar and of casein on the specific gravity.*—Since the publication of my paper on the relation between the specific gravity, fat and solids not fat, I have in very numerous cases compared the results obtained by direct analysis with those calculated by the formula, solids not fat $= \frac{\cdot 725 \text{ TS} \times \text{sp. gr.},}{4\cdot 33}$ and have invariably found that the results agreed very satisfactorily. I have never observed anything like the enormous, and apparently impossible, deviations described by Dr. Bell. As my formula is worked out without reference to the proportion of milk sugar and casein, it appeared desirable that the influence of these constituents be *separately* determined.

From the figures quoted in section I it follows, that 5·8694 grms. of crystallised milk sugar dissolved to 100 grms. of solution raised the specific gravity to 1022·25. Hence each per cent. of lactose raises the gravity by 3·791. Now as milk residues, properly dried, contain anhydrous lactose, and 5·8694 grms. of the crystallised correspond to 5·5759 grms. of the anhydrous substance, *each per cent. of anhydrous lactose raises the gravity by* 3·990.

4·1736 grms. of casein, fairly pure (but containing some ash constituents), and thoroughly dried, prepared from cow's milk, were dissolved in 97·4880 grms. of alkali solution of 1005·4 specific gravity. Total weight of solution 101·6616, bulk at 60° F. 100·1508. The bulk of 97·4880 grms. of alkali of the specific gravity 1005·4 is 96·9663.

Hence the bulk of the 4·1736 grms. casein=3·1845, or specific gravity of casein in solution=1·3106. Hence each per cent. of casein raises the gravity of a solution by 3·106.

Considering the slight variations which are observed in the proportion of casein and of milk sugar, occurring in mixed milk, for the same proportion of solids not fat the specific gravity could not vary to a greater extent than 2 per thousand. I would again insist upon the great utility to the analyst of formulæ such as have been worked out by myself and others. Whilst in no case I would condemn any sample upon calculated results alone, it is perfectly safe to pass every sample in which by calculation the quantity of fat and of solids not fat reaches the adopted limit.

A CRITICAL EXAMINATION OF DR. VOELCKER'S PUBLISHED STATEMENTS ON THE COMPOSITION OF MILK.

By Alfred H. Allen.

There are few Members of the Society of Public Analysts who do not remember a certain lecture delivered by Dr. Voelcker on March 2nd, 1874,* before the Members of the Farmers' Club. The analyses and statements made in that lecture were received by chemists with much astonishment and some incredulity. The position of Dr. Voelcker gave his statements great authority, and as he has repeated his statements on several recent occasions, it must be presumed that he is still prepared to vindicate them.

I purpose in this paper to consider how far Dr. Voelcker's statements are borne out by his published analyses, and how far they are consistent with the experience of other observers. I do this with some diffidence, as Dr. Voelcker's position as one of the fathers of professional chemists, and the high esteem in which he is deservedly held generally, are such as to give any statements and figures made on his authority a *prima facie* probability.

1. In his lecture before the Farmers' Club in 1874, Dr. Voelcker lays down and repeats the following proposition: "Good milk of fair average quality contains from 10½ to 11 per cent. of dry matter, including about 2½ per cent. of pure fat. It yields 9 to 10 per cent. of cream, and has a specific gravity of 1030."

Now this is a perfectly definite statement and one on which it is easy to join issue. The limits of natural variation in milk are not here the question, but simply whether the above description is true of "good milk of fair average quality," such as unadulterated milk from large dairies may fairly be expected to be.

On this point it is interesting to compare Dr. Voelcker's statement with the experience of other chemists, which is expressed in the following table.—

Description of Milk.	Total Solids.	Fat.	Solids not Fat.	Authority.
Average of 216 single cows..............	12·83	3·83	9·00	James Bell.
Average of 24 dairies	13·22	4·12	9·10	James Bell.
Average of 22 dairies, Manchester	12·74	3·37	9·37	C. Estcourt.
Average of 183 cows, Manchester District.	13·60	3·70	9·90	J. Carter Bell.
Average of 42 cows, Dublin.	13·47	4·00	9·47	J. Cameron.
Average of 100 cows, Dublin.............	13·85	4·60	9·25	C Cameron.
Average of 40 dairy cows, Dublin	13·00	4.00	9·00	C. Cameron.
Yearly average of weekly samples during 1879 of 120 cows at Raden	12·22	3·20	9·02	Flaischmann & Vieth.
Ditto 1880......	11·89	3·27	8·62	Fleischmann & Vieth.
Yearly average of 60 samples daily of dairy milk supplied to Aylesbury Dairy Co. in 1881	12·80	3·10	9·70	Vieth.
Ditto (9120 samples) in 1882	13·03	3·52	9·51	Vieth.

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* Published in full in the *Pharmaceutical Journal* for March 14th, 1874.

Description of Milk.	Total Solids.	Fat.	Solids not Fat.	Authority.
Average of 3 years from 10 cows at Kiel	12·16	3·51	8·65	Vieth.
Average of 40 cows, Edinburgh	12·27	2·58	9·69	S. Macadam.
Average of country milk	12·50	3·20	9·30	J. A. Wanklyn.
Average of cows' milk	13·13	3·50	9·63	A. Wynter Blyth.
Yearly average of 15 cows	12·80	—	—	Müller & Eisenstuck.
Average cows' milk	12·85	3·55	9.30	Marchand.
Ditto	13·00	3·10	9·90	Chevalier & Henry.
Ditto	13·60	3·60	10·00	Vernois & Becquerel.
Ditto	13·40	3·50	9·90	Payen.
Highest	13·85	4·60	10·00	
Lowest	11·89	2·58	8·62	
Average of above authorities	12·92	3·54	9·38	
"Good milk of fair average quality," according to Dr. Voelcker	10·75	2·50	8·25	
Yearly average of 15 Cirencester cows, according to Dr. Voelcker	12.10	2·95	9·15	

Of course all the figures which go to make up the average are not of equal value, but taking the results obtained by Dr. Vieth from the analysis of an enormous number of samples supplied by farmers to the Aylesbury Dairy Company during 1881 and 1882, the total solids (12·80 and 13·03; mean, 12·915) are found to agree almost absolutely with the average of the 20 authorities. The figure for fat in 1881 (3·10 per cent.), Dr. Vieth states is below the truth, so taking the figure for 1882 only, a most striking accordance with the general average is again exhibited. It appears from these figures that Dr. Voelcker's statement as to the proportion of solids in "good milk, of fair average quality," differs from the united experience of other observers by more than 2 per cent., and that there is not one who endorses his statement within about 1 per cent. Further, it appears that average milk might be diluted with one-fifth of its weight of water, and yet it would still be equal to Dr. Voelcker's description of "good milk of fair average quality." It is also a remarkable fact that Dr. Voelcker makes his statement respecting the average composition of milk in the very same lecture in which he quoted and laid stress of the results of analysis of the milk from the badly-fed Cirencester cows, which milk had an average composition of 12·10 per cent. of total solids including 2·95 per cent of fat; and that although the favourable month of August was excluded, and the cows were starving during a portion of the year. Recently, in evidence before the Recorder of Manchester, Dr. Voelcker stated that 8·5 was rather below the average proportion of "solids not fat." He also stated that he considered the Public Analysts' Society's limit of 2½ per cent. was too low, and he would recommend its being raised. He "should say it is decidedly too low a one. You may expect during the greater part of the year a higher percentage than 2½ of fat. The average is much nearer 3 than 2½."

2. In his lecture before the Farmers' Club in 1874, Dr. Voelcker gave the following table, showing accurately the specific gravities, at 60°F., of milk before and after skimming, and of samples *purposely prepared therefrom* so as to contain different amounts of added water.

Pure Milk.	Before Skimming.	After Skimming.
Pure milk	1031·4	1033·7
With 10 per cent. water	1029·5	1030·8
With 20 per cent. water	1025·7	1026·8
With 30 per cent. water	1023·3	1024·8
With 40 per cent. water	1019·0	1020·8
With 50 per cent. water	1016·3	1017·5

In the same lecture Dr. Voelcker states that "within certain limits the specific gravity is the most certain indicator of quality," and, "milk purposely watered yields only from 5 to 6 per cent. of cream, and has invariably a lower specific gravity than 1025." The startling inference from these premises is, that milk-dealers "*invariably*" add more than 20 per cent. of water when they adulterate milk, for otherwise the density would exceed the limit above mentioned.

Taking the figures of Dr. Voelcker's table, it appears that milk containing 25 per cent. of added water would have a density of 1024·5 (half-way between 1025·7 and 1023·3), which is a number very slightly different from 1025, which he takes as the lower limit of density for genuine milk. Yet, in his evidence before the House of Commons Committee on Adulteration (1874, question No. 5512), given at about the same date as his paper, Dr. Voelcker expressed an opinion quite incompatable with the above statement.

"Q. In the case which I allude to, half a pint of water had been mixed with a pint and a half of milk, and you think that adulteration to that extent ought always to be detected?" —Dr. Voelcker: "With the greatest facility."

3. Dr. Voelcker, in the same paper, puts the average amount of cream yielded by genuine milk at 10 per cent, and yet says "milk purposely watered yields only 5 or 6 per cent. of cream." It would appear from this that when milk is adulterated with water, the added water is commonly 40 to 50 per cent of the whole sample.

If necessary, I believe it might be shown that, of the numerous instances in which adulteration of milk has been conclusively proved, in not one case in twenty has the density of the sample fallen below 1025.

Dr. Voelcker also argues that the presence of an unusual amount of cream cannot lower the density of milk to the same extent as the addition of water, and immediately afterwards gives a table of results from which a diametrically opposite conclusion is deducible.

4. But the most astonishing part of Dr. Voelcker's lecture before the Farmers' Club is the table of analysis purporting to shew the composition of samples of the milk of the herd of fifteen cows supplying Cirencester Agricultural College. These samples were taken on the morning and in the evening of the first or second day of each month (except August) as long ago as the year 1862. "The cows were out at grass from May till the end of October, and as the herbage then became so scarce as not to afford sufficient nourishment, they were fed in the evening at the stall. Both the morning's and evening's milk in September were extremely poor. The poverty of this milk was therefore evidently due to an insufficient supply of food. Referring to the same samples, Dr. Voelcker stated in evidence, before the Recorder of Manchester, that the cows were poorly fed, they had not enough to eat."

The result of Voelcker's analyses of the milk of these half-starved cows is well known to have been that he met with instances of poorer milk than have ever been approached, much less reached, in the mixed milk from a herd of cows either before or since. Dr. Voelcker himself has never published nor quoted an analysis of similar milk, and has recently stated in evidence that he does not know of any other case where mixed milk has contained so small a proportion of total solids as 7·50 per cent. But while the proportions of total solids and solids not fat were so remarkable as to cause the accuracy of the analyses to be generally doubted, the proportions of ash are, if anything, still more startling and improbable, as will be seen from the following abstract of the results—

	Fat	Proteids.	Sugar.	Ash.	Water	Total Solids.	Solids not Fat.
Highest Result	4·12	3 62	6·56	1·15	90 70	14·00	10·32
Lowest Result	1 79	2 37	4 04	0·58	86 00	9·30	6·71
Average of	2·952	2 933	5·380	0·835	87·90	12 10	9·15

Besides the minimum of ·58 per cent. of ash (which occurred in presence of 9·70 of total solids and 6·71 of solids not fat), ·64 and ·66 per cent. were found. Yet the average ash is remarkably high, and in four samples *it actually exceeded* 1·00 *per cent.*, reaching 0·80 in six more. Dr. James Bell's *highest* ash from the milk of 216 *separate cows* is ·87 per cent., and it exceeded 0·80 per cent. in only eight cases out of 216.

The only authentic cases I have been able to find in which the ash of cows' milk exceeded 1 per cent. are the following :—

	Ash per cent.	Authority.
COLOSTRUM ; immediately after calving	1·18	Engling.
after 10 hours	1·55	
after 24 hours	1·02	
after 48 hours	0·96	
after 72 hours	0·82	
COLOSTRUM : from heifer with inflamed udder, two days after calving	1·16	Wynter Blyth.
COLOSTRUM ; one hour after calving	1·11	J. Carter Bell.
AVERAGE MILK from cows with mild form of typhus	1·85	Husson.

The four samples of milk, in which Dr. Voelcker states the ash to have exceeded 1 per cent., were from morning and evening milkings, taken on the first or second days in February and November respectively.

There is no mention of a large proportion of the cows having calved simultaneously about one or both of these dates, so that the theory of Colostrum is untenable ; and it follows that if Dr. Voelcker's figures for ash are correct, the animals were probably suffering from disease.

5. With respect to the lowest proportion of "solids not fat" present in the milk of the Cirencester cows, even Dr. Voelcker himself has recently declined to repeat the statements he made before the Farmers' Club. Thus the following replies were given by Dr. Voelcker in cross-examination before the Recorder of Manchester (Analyst VIII.—234).

"Q. Can you shew any average of milk of 15 or 16 cows giving less than 9 per cent.; I do not mean picking out exceptional cows ? A. Yes, I can ; that was 7·50."

"Q. With the exception of that case, do you know of any case where the average of milk of 15 cows has given solids not fat below 7·50 ? A. NO."

It is to be presumed from this that Dr. Voelcker himself felt it necessary to repudiate the analysis which shewed solids not fat 6·71 per cent., though belonging to the same series as the 7·50 figure.

6. A series of analyses, which appear open to criticism, are contained in a Report on Condensed Milk, published by Dr. Voelcker in the *Journal* of the British Dairy Farmers' Association, and reprinted in The Analyst (Vol. VI., page 221). In the report in question, Dr. Voelcker states that "really good condensed milk, as a matter of fact, is always made from skim milk or from milk unusually poor in cream." He also states that "none of the five samples (of sweetened condensed milk) analysed by me were produced from whole new milk, but from more or less skimmed milk."

Without disputing the truth of this proposition, it is of interest to see whether it is borne out by Dr. Voelcker's analyses. In two cases it is, but in the other three, all of which are described by Dr. Voelcker as well-made condensed milk, it certainly is not, as will be evident from the following figures :—

	No. 1	No. 3	No. 5
Fat	9·92	10·60	9·53
Casein	9·19	8·82	7·43
Ash	2·23	2·17	2·21
Ratio of Ash to Fat	1:4·44	1:4·90	1:4·31

In his lecture before the Farmers' Club in 1874, Dr. Voelcker states that "good milk of fair average quality contains 2½ per cent. of pure fat." Recently, Dr. Voelcker made in evidence the statement that the average proportion of fat in milk was much nearer 3 than 2½ per cent. The discrepancy does not greatly affect the argument in the test. The average of the ash he found in the milk of the herd of Cirencester cows analysed during a period of 12 months was ·88 per cent. Assuming this somewhat high figure as the average proportion of ash in milk, it follows that in milk of average quality the ash bears the proportion to the fat of 83 to 250, or 1 to 3·01. So, although the sugar added would tend to raise the ash of the samples and reduce the ratio of ash to fat, the samples nevertheless contain considerably more fat than average milk, according to Dr. Voelcker's own figures. If the more accurate ratio of ash to fat of ·72 : 3·40 = 1 : 4·72 be taken, two of the samples are slightly deficient in fat. The relative proportions of casein and fat are equally inconsistent with Dr. Voelcker's statement that skimmed milk was employed, but the data are not so conclusive, and therefore the discrepancy is not so startling as when the proportions of ash and fat are compared.

Assuming that a concentration to one-third had been effected in the preparation of the three samples already referred to (a conclusion justified by the proportion of ash), the original unconcentrated milks must have contained 3·31, 3·52, and 3·18 per cwt. of fat respectively, or in each case a proportion considerably higher than that stated by Dr. Voelcker to be present in "good milk of fair average quality."

In the same report Dr. Voelcker gives the following analyses of three samples of unsweetened condensed milk, not one of which bears out his allegation as to skimming:

	No. 1	No. 2	No. 3
Fat	16·02	17·09	14·33
Casein	8·50	7·62	11·69
Sugar	16·32	16·22	19·51
Ash	2·20	2·15	2·75
Ratio of Ash to Fat	1:7·28	1:8·00	1:5·20

In these samples the results are not complicated by the addition of cane sugar, so that the concentration which has been effected may be very fairly calculated from the proportions of casein, sugar, and ash present. These are such as to indicate a concentration of the original milk to about one-third in Nos. 1 and 2, and to about one-fourth in No. 3. On this assumption, No. 1 contained before concentration $\frac{16 \cdot 02}{3} = 5 \cdot 34$ per cent. of fat; No. 2, 5·70 per cent.; and No. 3 $\frac{14 \cdot 33}{4} = 3 \cdot 58$ per cent. of fat. So that *it appears from Dr. Voelcker's figures that remarkably rich milks were employed instead of partially skimmed milk.*

LAW REPORTS.

Singular Charge of Selling Adulterated Whiskey.—Samples Changed:—

At the Droxford Police Court, recently, before Admiral Murray-Aynsley and Captain Butler, William Pink, of the "Roebuck," Soberton, licensed victualler, was summoned for selling to Henry Luttrell, County Police Sergeant, half a pint of whiskey adulterated with water to the extent of 29·2 degrees. Mr. G. H. King appeared for the defence. It appears that on the sergeant taking the whiskey the landlord declared that it was pure, for it was pure as sent to him by his spirit merchant. The spirit merchant, who felt confident the article which he had sent was pure, consulted his solicitor, with the result that he attended before the Droxford Bench on the 11th October, and asked that the third sample should be sent to Somerset House for the purpose of being analysed, as his client, Mr. W. J. Hunt, of Southwick, wine and spirit merchant, had caused the second sample to be sent to London, to Mr. Sidney Harvey, who had declared the sample to be only 9·2 degrees under proof. The Bench acceded to the application, and the sample was sent to Somerset House, with the result that the analysis came back stating that it was only 8 1-17th under proof. Mr. King now attended before the Bench at Droxford, and the case was dismissed. He then applied for costs, and in doing so said it was a very serious matter for his client, Mr. Hunt, whose reputation would have been seriously injured had he not felt so convinced that the spirits sent out by him were perfectly pure that he sent a sample to be analysed. The wrong analysis by the County Analyst must have arisen from negligence or incompetence, as he had made it 29·2 under proof, which showed a difference of 20 degrees. The Magistrates coincided with the views expressed by Mr. King, and made an order for £9 9s. costs, directing the police to have the attention of the proper authorities called to the great discrepancy in the analyses.

Milk Adulteration Extraordinary:—

The contractor who supplied milk to the 3rd Regiment of the Line (the "Buffs"), at Ship Street Barracks, was fined £20 on the 9th July, by the Dublin Police Magistrates, for selling milk which, according to Dr. Cameron, was adulterated with 243 per cent. of water—that is nearly 2½ gallons of water had been added to a gallon of milk!

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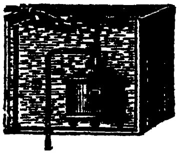

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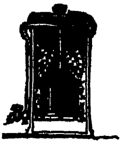

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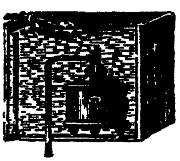

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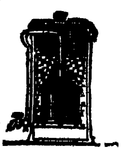

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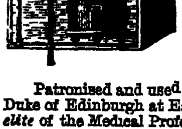

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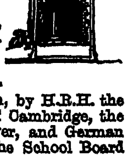

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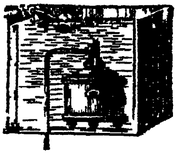

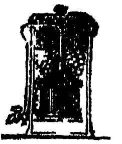

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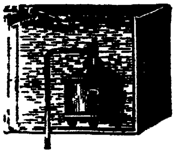

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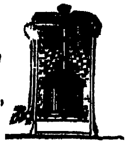

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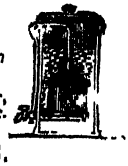

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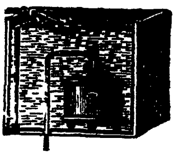

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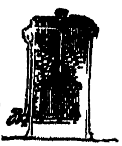

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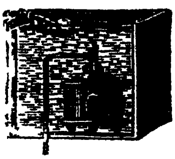

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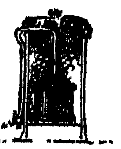

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